ENGINEERING NEWS

THE NEW ARMED CRUISER, for which bids were opened on April 3, is a novel departure in design, and it is expected that she will be the most formidable war vessel of her displacement in the world. She approximates the monitor form and is of 5,000 tons displacement in cruising trim. She will be 261 ft. long, 49-ft. beam, and 14½ ft. deep, with a speed of 16 knots. At this speed she can cruise 632 miles, or at 9 knots, 2,727 miles without renewing her coal supply. In action the vessel can be sunk by water ballast until her deck is only 16 ins. above the sea surface. The armament will be very formidable. In the forward barbette, armored with 16 ins. of steel, she will carry one 16-in. rifle weighing 110 tons, and 49 ft. long. In the rear barbette will be a 12-in. rifle weighing 46½ tons. These guns will be mounted on turn-tables, and manipulated by hydraulic power. The bids were very close, as follows: Cramps, $1,614,000; Union Iron Works, San Francisco, $1,628,950; and the Quintard Iron Works, New York, $1,690,000. As she will probably be sent to the Pacific coast, the San Francisco firm may get the contract.

TWELVE SIX-INCH ORDNANCE RIFLES for the United States Government are now being built by contract, six each at the South Boston Iron Works and the West Point Foundry. The forgings and material for the guns are being made by the Midvale Steel Co., of Philadelphia, their contract being directly with the Government. The contract for the guns was made last November, with the provision that the first gun should be completed within six months. The construction of the guns is under the supervision of a naval officer, Lieut.-Commander EATON, U. S. N.

THE SOUTH BOSTON IRON WORKS also have the contract for furnishing the gun-carriages, gun mechanism, and steering-gear apparatus for the double-turreted monitor *Terror*. The price is $200,000, and it is required that the work shall be completed and erected on the boat one year and six months from May 1.

The gun-carriages for the *Terror* are of the pneumatic type, the recoil and counter recoil is against cushions of air. The gun on this carriage will run on a horizontal plane, instead of on an incline, as in the Sicard carriage on the *Boston* and *Atlanta*. The first of these new carriages is already at the Annapolis proving grounds and will be tested immediately. The cost to the Government of this carriage is to be $19,000.

The *Terror's* guns will be elevated by hydraulic power applied under the after-part, the pivoted point being on the gun port. The gun is loaded from a three-cylinder revolver, the gun being lowered after firing until its chamber is in line with that of the cylinder, at which moment a hydraulic rammer pushes the charge into the gun. This arrangement is similar to that used on the *Vesuvius*.

Besides the work already mentioned, the South Boston Iron Works are furnishing 200 projectiles for the new 12-in. rifle mortar, now at Sandy Hook, and the only one in the United States. The projectiles are of cast-iron, pointed, with two copper bands about one-fourth inch wide shrunk on their exterior to permit their taking the rifling. The projectiles cost about $50 apiece.

THE MERCHANTS' BRIDGE, at St. Louis, is under way. The west side caisson is being sunk, with a near prospect of reaching the rock. The 46 ft. of material passed through has been mainly sand and mud; but the caisson is now said to be on a stratum of cinders and ashes, where the excavation is slow. The east side caisson is under construction, and it is expected that it will be in position for sinking next week.

OPPOSITION TO THE MERCHANTS' BRIDGE is being rapidly developed by rival interests in St. Louis, says the *Globe Democrat*. The St. Louis Transfer Railway Co. is already attempting to block, with side-tracks and switches, the use and occupancy of certain portions of streets essential to the purposes of the Merchants' Bridge Terminal Co. If these "improvements" stand, they will effectually shut out the latter company from access to the central part of the city. A temporary injunction has been secured against the St. Louis Transfer Co.

THE WINNER BRIDGE, to cross the Missouri river at Kansas City, was incorporated this week with $2,000,000 capital stock. The incorporators are W. E. WINNER, F. W. PERKINS, C. A. PEABODY, O. B. COPELAND and J. W. PERKINS.

A STATE SURVEY is being urged for Connecticut. Prof. BREWER, of Yale, says that there are better maps of the moon than of the State referred to,—a condition of affairs that could be speedily reversed, to say the least, by arranging with the U. S. Government and following the excellent example of New Jersey, Massachusetts, and Rhode Island. Even the size of Connecticut is not known by several hundred square miles, says Prof. BREWER, and all estimates of comparative areas are guess-work. A bill now before the Legislature provides for an expenditure of $5 per square mile for a survey made in conjunction with the U. S. Geological and Geographical Survey.

THE COTEAU LANDING BRIDGE across the St. Lawrence river has been commenced by the Canada Atlantic Railway Co. The bridge crosses Clarke's Island and will be 6,031 ft. long from shore to shore. The average depth of water is 24 ft. The Dominion Bridge Co. is to build the superstructure, and the estimated cost of the work is $1,500,000. This bridge and the Canada Atlantic R. R. will connect with the Canadian Pacific at St. Polycarpe and shorten the distance between Montreal and Boston about 60 miles.

THE UNITED STATES CIRCUIT COURT has approved of the disclaimer filed by the Electrical Accumulator Co., and formulated the decree and injunction restraining the Julien Electric Co., their officers, agents, and workmen, from further manufacture, use, or sale of secondary batteries of the Faure type, in which the active material is applied in the support in the form of a paint, paste, or cement.

THE STATE DEATH RATE OF CONNECTICUT, as reported by the State Board of Health, is between 17 and 18 per 1,000. This is lower than in Massachusetts, and lower than the European average. Analyses of the drinking water of 17 of the largest cities and towns show that Hartford stands at the head of the list for purity of supply.

HAVANA IS TO BE SEWERED and offal furnaces are to be established, under a late decision of Captain-General SALAMANCA. A complete sewerage system is contemplated, says the New Orleans *Picayune*.

PILES 112 FT. LONG are being put down in Boston, Mass., by Mr. G. H. CAVANAGH, in the effort to secure proper foundations for certain buildings in that city. The Boston *Herald* says that one-third of Boston is now resting on these spruce stilts, though in ordinary cases a length of 30 ft. is sufficient. But in certain localities "mud-holes" occur which require piles of over 100 ft. in length to reach firm bottom. The piles lately driven at Ruggles and Westminster streets were made up of hard pine sticks 10 x 10 ins. square and 42 ft. long. The sections were spliced by banding both ends and inserting an iron plate and completing the splice with four pieces of oak, 2 x 10 ins., An 1800-lb. hammer was used in driving.

THE REPAVING OF PENNSYLVANIA AVENUE, Washington, D. C., is to be let to the lowest bidder, according to the decision of Capt. RAYMOND that the work differs from ordinary repair work because it contemplates a change of grade and a surface wearing material of a different thickness from anything specified in the contracts of Mr. CRANFORD, who has an existing repairing contract. The last appropriation bill contained a special appropriation of $125,000 for resurfacing and repairing this avenue.

THE 48-IN. PIPE for the increased water supply of Washington, D. C., will aggregate 4 miles in length. The Deficiency Act of the last Congress, approved March 2, appropriates $250,000 for this purpose, and the material must be furnished within six months. The pipe will connect the Georgetown reservoir with the old 48-in. pipe laid several years ago.

THE BRAZOS RIVER IMPROVEMENT contract has been ratified, and considerable work has already been done in preparing for the jetty construction. It calls for 20 ft. of water in the ship channel within two years. An air-line railway is also to be built from the mouth of the Brazos to Houston, with a branch to Arcola on the Gulf, Colorado & Santa Fé R. R. This Brazoria & Northern R. R. will be 65 miles long, and is estimated to cost $15,000 per mile. It is expected that it can be finished by Sept. 1, next.

THE LIVERPOOL OVERHEAD RAILWAY CO. is the title of a proposed new line in Liverpool and is the English equivalent for an elevated railway. It is to be six miles long, double track, and to extend along the line of the Liverpool docks. The capital is $1,875,000 and Sir DOUGLAS FOX and Mr. J. H. GREATHEAD are the engineers. The wonderful growth of traffic on the "Overhead Railways" of New York is quoted as an inducement to stockholders, and the road is evidently to be modelled on the best American practice of posts and plate girders.

GERMAN RAILWAY REPORTS, for 1887-88, claim 39,805 kilometres of track, or 26,479 miles. The rolling-stock and buildings included 6,613 stations, 12,811 locomotives, 23,703 passenger cars, 518,526 freight-cars, and 1,587 mail-cars. The cost of this material was about $379,024,987 and the total value of German railways is set down $2,475,538,737. In the fiscal year 1887-88, the German railways transported 315,991,747 passengers, and 178,814,667 tons of freight. In this service the locomotives made a total mileage of 252,463,800 miles. The number of employés and laborers of all kinds connected with the railway service amounted to 343,000. The total receipts from all lines were $272,951,539, and the total expenses were $128,380,449; the percentage of operating expenses to income being about 53.7. At the date of the report, out of 40,617 kilometres of single tracko nly 24,458 kilometers were yet laid with steel rails.

THE CORINTH CANAL, like its bigger brother at Panama, will considerably exceed the original estimate of cost. When commenced in 1883, $5,000,000 was the estimate of cost and 5 years time was allowed for its completion. It is now expected to cost $9,000,000 and to be finished sometime in 1890. The four miles of canal will require about 8,430,000 cu. m. of excavation, and at the end of last year 5,200,000 cu. m. had been removed. In extenuation of the extra outlay necessary, the promoters point to the Suez Canal, which was to be built for $40,000,000 and really cost about $100,000,000, and also the later and greater discrepancy between estimate and actual expenses at Panama.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision April 2, on the Northern Pacific at Prickly Pear Junction, 6 miles east of Helena, Mont., where the Wickes branch leaves the main line. The accident was caused by an open switch. On one of the side-tracks a double-header freight train, west bound, had been backed to clear the main track for the regular passenger, east-bound, which was due at that time. The freight had just backed on to the siding when the head-light of the passenger train was seen approaching. The brakeman whose duty it was to reset the switch, claims he could not reach it in time, and the passenger train dashed into the freight. The three engines and several cars were wrecked. Three men were killed.——A serious rear collision occurred April 10, at Lorenzo Station, Ill., on the Chicago, Santa Fé & California. A passenger train was pulling out, when a following extra freight ran into it. Four persons were killed and 4 injured.

BRIDGE ACCIDENTS are reported as follows: On April 6, the railway trestle over Stevens creek, between Waverly and Havelock, Neb., was destroyed by fire.——A highway bridge at the Henry Clay furnace, Lancaster, Pa., crossing the canal and the Pennsylvania R. R., was burned a few days ago.

FLOODS AND HEAVY STORMS have occurred in Virginia. A washout on the York River branch of the Richmond & Danville road caused the wreck of a freight train April 6; two men were killed.——Wind storms and prairie fires have done much damage in Minnesota and Dakota.

THE CHINA RAILWAY, of which we gave a description in our issue of Dec. 22, 1888, is a continuation of a line built from the Kaiping mines to a canal 7 miles distant in 1880; it was extended to Lutai in 1887, and to Taku at the mouth of the Pei Ho and beyond to Tientsin in 1888. The extension to Tungchow, 12 miles from Pekin, was located in January last, but work was stopped by the opposition. There is little doubt that the 7th Prince will, however, help the company through, and that the 60 miles will soon be put in hand. There are no other railways in China, but a line of 3 ft. 6 ins. gauge is being built in the island of Formosa, opposite Foochow. The China road is standard gauge, with American types of rolling-stock, built chiefly in China; locomotives and bridges from the United States and England. The above is taken from a letter written in February by Mr. C. W. KINDER, Chief Engineer of the China Railway Co., and he adds: "The graves are most difficult to deal with," alluding to the custom of burying bodies at the most convenient place, and as the Chinese strongly object to the disturbing of the graves, the railway company has had a singular difficulty to contend with in its location and construction.

ELECTRIC LIGHTING FOR PHILADELPHIA is occupying the present attention of the Councils of that city. The displacement of gas by electricity for street lighting has been on the whole so satisfactory that its extension is called for. As an example of cost, a list of 21 different cities is given, where electric light is supplied by private companies; the average cost in the 21 towns is 53¾ cts. per lamp per night. Another list of 18 towns is also given, where electric light is furnished by city works, and the average cost is 13$\frac{7}{10}$ cts. This disparity is taken to mean that the city had better provide and control its own plant.

THE MEXICAN GULF CANAL, now under construction, will connect New Orleans by 8-ft. navigation with Mobile bay and the Alabama coast generally. The connection with the Mississippi river will be by locks, and the vessels to be immediately benefited will be the small craft transporting lumber, brick, shell, lime, etc., though a greater future traffic is expected.

HOW TO KEEP INFORMED ON RAILWAYS.—Any person who tries to be informed on the numerous and sometimes bewildering extensions of railway systems in the United States will have his labor very much lessened by using the fine new railroad atlas published by ENGINEERING NEWS. As these maps have been adopted for some purposes by POOR in his "Railroad Manual," their correctness is guaranteed. An interesting feature of some of the supplementary maps lately published is the graphic delineation of the large railway systems by means of different colors and prickings.—*New York Sun.*

A New Aluminium Process.

In the course of a discussion upon a paper read by Mr. W. ANDERSON, before the Society of Arts last week, on the DEVILLE-CASTNER aluminium process, Mr. ALEXANDER SIEMENS described a new process invented by Mr. GRABAU, who heated fluoride of aluminium in presence of sodium. The melted sodium was poured into the vessel, which was lined with cryolite and cooled by water; and the heated fluoride of aluminium, in the form of powder, was thrown upon the melted sodium. Very violent reaction took place, the heat generated by the reaction being sufficiently great to melt the aluminium as well as the by-product. As soon as the reaction was complete, the whole molten mass could be poured out into suitable forms, and the aluminium settled at the bottom and the cryolite at the top.

To obtain the fluoride of aluminium, Mr. GRABAU used the cryolite, which he procured by the final reaction, by putting the powdered cryolite into a solution of sulphate of aluminium. The reaction which took place between the sulphate of aluminium and the cryolite gave the aluminium fluoride. The solution was afterwards evaporated, and the residue was washed with water, which took out the sulphate of sodium and left the aluminium fluoride ready to be reduced.

The advantages of this process were that all the materials were treated at a comparatively low temperature, about 900° Celsius. The vessel in which the aluminium fluoride was heated, as well as the vessel in which the reaction took place, was lined with cryolite, so that there was no danger of impurities being imported into the aluminium. The low temperature was very much easier managed than the high temperatures of the Castner process. The Grabau process of course required the action of sodium, and the inventor was engaged in experimenting upon a new process to prepare this. A factory was at work near Hanover, producing aluminium on a commercial scale.

The Construction and Repair of Roads.

At a late meeting of the London Society of Engineers, a paper was read on the above subject by Mr. GEORGE R. STRACHAN, Assoc. M. Inst. C. E. The paper was confined to town roads under heavy traffic, and the costs given applied to the metropolis. The standard of traffic weight adopted was tons per yard of width per 16 hours. Macadam roads had narrow limits in heavy traffic, and modern practice differed from Macadam's practice in three things—in the use of (1) binding material, (2) foundations, and (3) pavements. As to the use of a binding material, Macadam obtained it from the wear of the stones under the traffic, whereas modern road makers added it at once, and claimed that their practice was more economical, humane, and expeditious. As to foundations, their use gave equal carrying capacity at a less expenditure of material, and was therefore more scientific. As to paved roads, which Macadam regarded as an actual evil, modern road makers claimed that their use was necessary under heavy traffic. A macadam road was a mass of inferior concrete, made with small stones and a plastic, binding material of dirt, and was not a body to stand severe traffic. Macadam roads, as made in the metropolis, with hard core and broken granite, cost from 3s. 10½d. to 5s per sq. yd. A 2¼ in. stone was suitable for heavy traffic. Granite chippings were not a suitable binding material, and a concrete foundation did not add to the life of the surface. The repair of macadam roads with 2 ins. of new stone cost 1s. per sq. yd. The ratio of cost to traffic was a rapidly increasing one.

When Piccadilly was a macadam road, the annual cost of maintaining it was 4s. per square yard, which for a road 36 ft. wide equalled £4,224 per mile per year. The true principle of road construction was to make the foundation the real road, and the material thereon a wearing surface only. Its use secured economy in construction and maintenance. Roads should be made to suit the vehicles using them, and not the vehicles to suit the road. A concrete foundation 6 ins. thick would carry 600 tons per yard per day without deterioration. It should be constructed carefully, accurately, and scientifically, for it was the actual road. Asphalt as a wearing surface was the best in use to-day, as it possessed the advantages of durability, cleanliness, economy, and healthiness, which outweighs its slipperiness. When laid 2¼ ins. thick, it gave a life of 15 years in Cheapside, at a cost of 13s. per square yard. The first cost of such a road 36 ft. wide equalled £12,788 per mile, and the average annual cost for repairs equalled £528 per mile.

The asphalt could be renewed at half the original cost, and a life of 15 years was again before it. Wood was a useful wearing surface. Swedish yellow deal had given 10 years of life under a traffic of 600 tons per yard per day, and the wear had not exceeded 3 ins. The cost was 9s. 6d. per sq. yd., not taking credit for old material, and the annual cost of repairs 3d. per sq. yd. The first cost of such a road, 36 ft. wide, equalled £9,982 per mile, and the annual average cost for repairs equalled £264 per mile. Soft woods were preferable to hard woods. Creosoting blocks added to their life, and were advisable for severe traffic. Wood was not suitable for light traffic. Stone pavements were practically prohibited by the noise they made. A 3-in. by 7-in. Guernsey granite paved road on concrete cost 15s. per sq. yd., and gave 15 years' life. The first cost of such a road, 36 ft. wide, would be £15,840 a mile, and the annual repairs £88 per mile.

Test-Borings for Foundations.

In a late issue a correspondent asks that we describe various methods of making test-borings for foundations, etc. This is an important and interesting subject to engineers, and one in which nearly every engineer has had greater or less experience. A detail of this experience would add a valuable chapter to engineering literature, and as a start in that direction the following matter is presented.

The variety in material to be penetrated and the varying conditions under which the borings must be made, make it impossible to advance any system of common application. If rock strata are to be tested, the diamond drill, removing a core, is undoubtedly the most satisfactory and the only practicable method of finding out what the rock is like. The next most difficult boring is through a small boulder or cobble-stone formation for the purpose of discovering what is under it. Here a casing-pipe and a light artesian well rig is the best known to the writer; and test-holes through this formation are expensive, and may cost $1.00 or even more per linear foot of depth of hole.

Fig. 1.

In sand, clay, gravel, and quicksand with small boulders, one of the best tools for exploration is the well-borer made by the Pierce Well Excavator Co., of 80 Beaver St., New York. These tools were extensively used in the test-borings in the softer materials made for the Nicaragua Canal surveys. In the cuts here given Fig. 1 is a sand-auger, 10 ins. in diameter, used in connection with a casing-pipe. This auger is surmounted by a cylinder provided with bottom valves of leather, which latter open to receive the sand lifted by the auger. It is claimed that this tool will penetrate the gravel and settle or draw down a tube through heavy bodies of quicksand. It has the important advantage of being provided with an air-passage, fitted with valves, in the center of the stem,—a device which destroys suction and permits the tool to be more readily withdrawn from the pipe.

Fig. 2 shows a well-auger, which the makers guarantee will penetrate hard-pan and frozen earth and work among boulders. The cutters are arranged to draw the auger into the earth, and it carries its own load to the surface. It is turned either by two men with wrenches hooked to the square bar, or in more extensive works, by horse-power. This auger is used to depths of 60 or 100 ft., though under favorable conditions it is said to be good for 300 ft. The drilling outfit is a simple affair, consisting of a folding tripod with two of the legs braced in ladder-form and provided with a drum for the hoisting rope.

Fig. 2.

Fig. 3 is another auger made entirely of steel and varying in size from 2¼ to 7 ins. It is provided with a removable casing and valve for use in sand, and is made either for a square socket or a screw-coupled stem. This auger is very considerably used in prospecting for kaolin

Fig. 3.

and fire-clay and for boring small wells. In use a hole is first bored until the material commences to cave; a pipe is then inserted, and another smaller auger used to continue the boring. These augers cost from $12 to $35 according to size, and the

hollow, screw-jointed rods used with them cost about 12 cts. per linear foot.

Other tools, and particularly their use under the special conditions of engineering exploration, will doubtless be suggested by this brief notice; and if this practical, personal experience is made public the aim of the writer will be gained.

A New Bar Channeler.

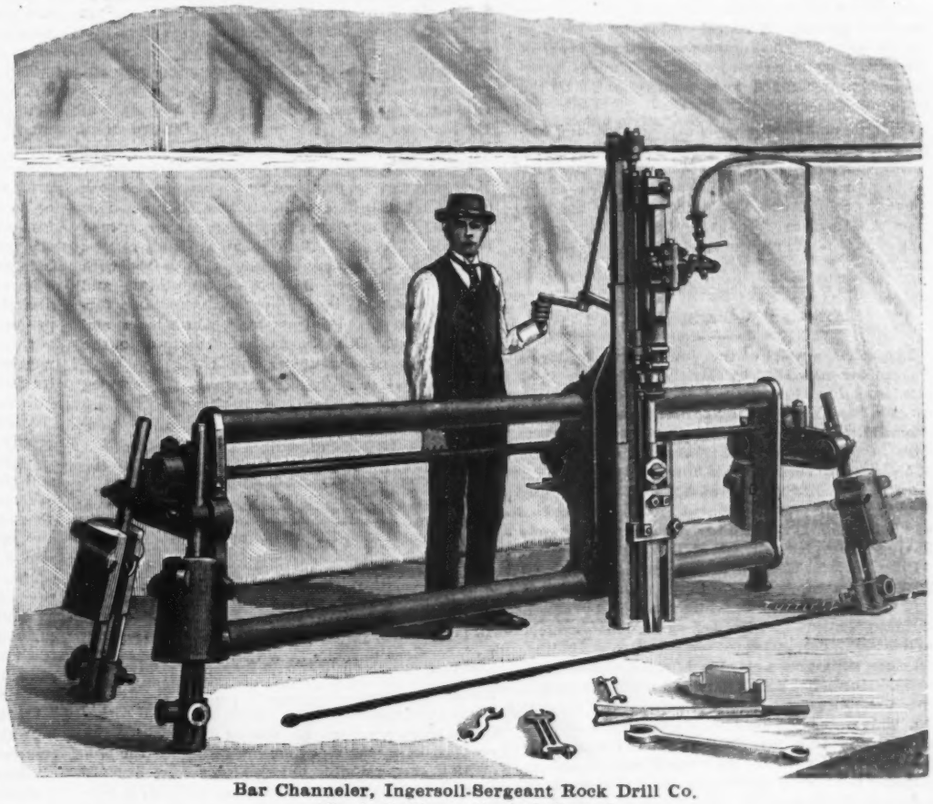
The tool which we illustrate by two views herewith is an entirely new quarrying machine, which has been introduced during the past year by the Ingersoll-Sergeant Rock Drill Co., of New York. The machine is known as a "Bar Channeler," a term used to distinguish it from "Track Channelers," which, before the introduction of this machine, were the only channeling machine used in the quarries. The bar channeler is the result of experiments carried on during several years past by Mr. WM. L. SAUNDERS, C. E., looking toward the adaptation of the principles embodied in the percussion drill to the varied requirements of stone quarrying.

Channeling machines were built 25 years ago, and before the perfection of the percussion drill; hence, in order to reciprocate a gang of chisels, it was necessary to mount an engine carrying the drills on a frame or car moving upon wheels. This involved an expensive machine, one adapted only to large, level-floor quarries. Besides requiring a track to be laid in the quarry, it was not possible to adapt the machine properly to the corners and angles following the dip of the stone. The first step made in advance of this was to mount an ordinary rock drill (using of course a different bit) upon a truck moving on wheels, in much the same way as the first channeling machines were mounted; and the success of this direct acting channeler on wheels, with the experience gained thereby, made the bar channeler possible. The drills mounted on a bar channeler are either the "Ingersoll" or the "Sergeant," both of them having the variable stroke, a feature so very desirable for cutting channels. The speed of direct acting rock drills is such that, carrying the same chisels in the gang, they out-cut machines which depend upon the revolution of the crank to strike the blow. The blow of the rock drill mounted on a bar channeler is under control, so that a hard or a light blow may be struck, thus maintaining an even bottom to the channel. A very important consideration in favor of the bar channeler is that it strikes a number of rapid blows which do not jar the stone; thus the channeler, instead of striking 100 heavy blows per minute, does the same amount of work by striking 250 light blows; and it is stated that quarrymen who have had experience with the machines find that the stone is not jarred at all, but is in marketable shape at the very face of the channel.

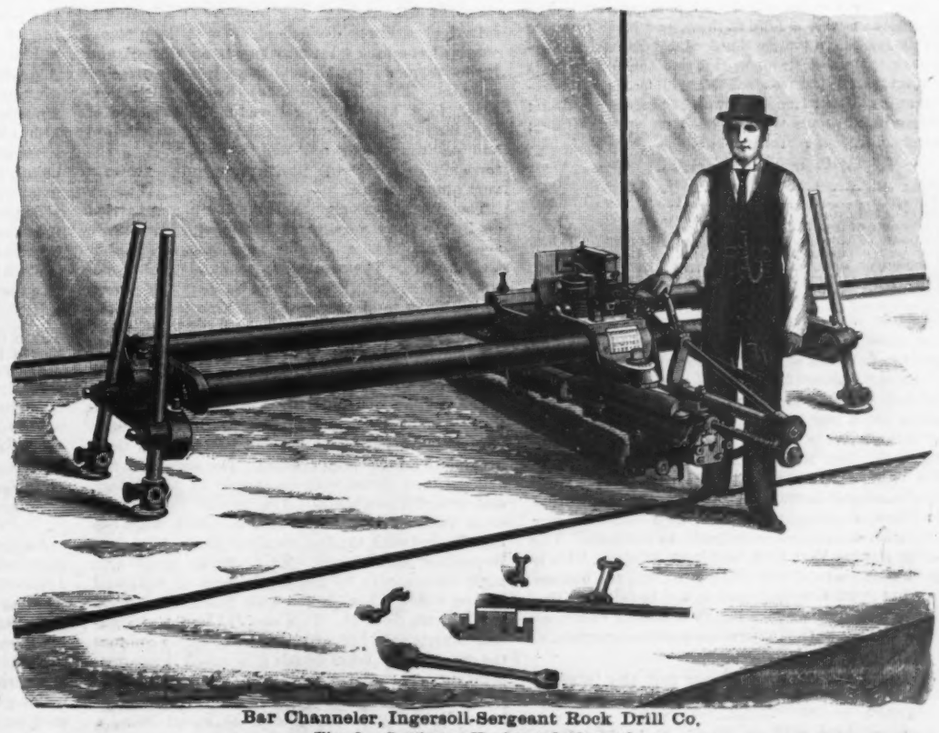
The two views show the bar channeler in use for both horizontal and vertical channels. It can of course be used likewise as a drill in either position simply by changing the cutting tool. After holes have been drilled, one at each end of the bar, a cross-head and clamp, carrying chisels, are inserted, and a channel cut between the two holes. The change from the drill steel to the channeling chisels occupies but a moment's time. The advantage of the hole is that the cuts do not run off at the end. After the channel has been cut to the depth required, the bar channeler is moved its length by being pinched along the quarry floor with crowbars, the legs of the machine being provided with shoes and projecting lugs for the purpose. It will readily be seen that the next cut covering the length of the bar requires only one hole, as the end of the previous cut takes the place of a hole. Moreover, the deep cut forms a receptacle for the cuttings, requiring less labor in spooning out the cut. The bar channeler is capable of angular adjustment in every direction, horizontal cuts being made with the same facility as vertical cuts.

The machine is now in use in marble, sandstone, and limestone. The Chicago & Indiana Brown Stone Co., of Mansfield, Ind., have cut 1,400 sq. ft. of channel per month, we are told, and they used the bar channeler for all the machine work required in removing the stone from its place in the bed. In some quarries, cuts have been made to a depth of 10 ft.

It is claimed that the bar channeler will run at less expense in fuel, labor, and repairs than any other channeler, only one man and a helper being required to run it. In making the cuts, the chisels



Bar Channeler, Ingersoll-Sergeant Rock Drill Co.
Fig. 1.—Cutting a Vertical Channel.



Bar Channeler, Ingersoll-Sergeant Rock Drill Co.
Fig. 2.—Cutting a Horizontal Channel.

are directly under the center of the piston-rod, and are connected with the piston by means of a dowel shank of less sectional area than the piston-rod itself, so that it is next to impossible to break the piston.

A quarry was recently opened by Messrs. Davidson & Sons, at Gouverneur, N. Y., in what is known as "Gouverneur granite." All the channeling was done by the bar channeler, and the drilling with an Ingersoll gadder. Six weeks after the opening of the quarry the machine produced 22 car loads of marketable stone, a record which, with much apparent reason, is claimed to be unprecedented in the history of quarrying.

The cuts make sufficiently evident, without further description, the general character of the mechanism, which certainly seems to be well designed for the purpose in view. The advantage in the way of convenience and economy of having the machine supply its own track is evident; and its reach is long enough not to render its resetting a very serious matter.

Artesian Wells in Dakota.

The artesian wells of the James River valley in Dakota are described by Mr. L. T. Korns, in a late issue of the *Scientific American*. This valley extends from Yankton to Jamestown, a distance of 300 miles. The first artesian well was sunk at Aberdeen in 1882, and was 961 ft., deep with a diameter of 5⅛ ins. In 1886 the same town put down a well 908 ft., with a diameter of 5⅛ ins. Water was found giving a pressure of about 200 lbs. per sq. in., and this power is utilized in driving sewage pumps having a pumping capacity of 50,000 galls. per hour.

Ellendale, 35 miles north of Aberdeen, has a well 1,087 ft. deep which supplies to the town a clear and soft water, with a temperature of 67° Fahr. and a surface pressure of 150 lbs. per sq. in. The Redfield well is 960 ft. deep, with 68° temperature and 200 lbs. pressure, supplying water for domestic and fire purposes. Huron has a well 863 ft. deep with a 6 in. diameter, yielding water at 60° and a pressure of over 200 lbs. This water supplies the town through 4 miles of pipe, and besides furnishes 20 H. P. for running motors. The Redfield and the Huron wells are probably the best in the valley. The two Yankton wells are 600 ft. and 610 ft. deep, furnish fire protection through 19,400 ft. of pipe, run the electric light motors, two printing presses, etc. The pressure is about 56 lbs. and the temperature is 62°. The Jamestown well is 1,576 ft. deep, and has a pressure of 100 lbs. and a temperature of 75° Fahr. It supplies a system of water-works, and the following is an analysis of the water of this well: Jamestown—organic matter: free ammonia, 2.4 parts per million; albuminoid ammonia,, 0.046 part per million; nitrites, traces; nitrates, none.

INORGANIC MATTER.

Silica	35.75	2.0823
Alumina	3.50	0.2041
Carbonate of iron	2.20	0.1283
Carbonate of lime	188.00	10.7643
Sulphate of lime	249.00	14.5243
Sulphate of magnesia	154.30	8.9944
Sulphate of soda	1,139.40	66.3602
Chloride of sodium	369.10	21.5296
Sulphate of potash	31.05	4.7526
Phosphates		a trace
Hardness		21°

A number of other wells of almost equal value and pressure are scattered about this valley, many of them yielding 3,000 galls. per minute. Great caution is required in sinking these high-pressure wells, for if any accident happens to the tubing after the water is struck, it is almost impossible to repair it. The wells at Frankfort and Groton, in this valley, have thrown muddy water ever since they were put down, and there is every indication that great cavities are being formed below the surface, with consequences difficult to estimate. The writer figures that in a well 1,000 ft. deep, with a surface pressure of 200 lbs. per sq. in., the bottom pressure (with the top closed) would be fully 630 lbs. per sq. in. The danger lies in a lateral escape of this water above the impervious artesian stratum.

The Deville-Castner Process for the Manufacture of Aluminium.

From a paper read on March 13 by Mr. Wm. Anderson, M. Inst. C. E., before the British Society of Arts, the following matter is abstracted relating to the manufacture of aluminium by the Deville-Castner process:

In the Deville process the aluminium is obtained by the reduction of the double chloride of aluminium and sodium by means of metallic sodium. As nearly three times in weight of sodium for one of the metal sought was required, the price of aluminium depended greatly on that of sodium. Before the Castner process was introduced, sodium was worth about 5s. per pound; now it can be procured for 1s., and this improvement has reduced the selling price of 98 per cent. pure aluminium to 20s. per pound. The Aluminium Co's. works at Oldbury, near Birmingham, now has a capacity of 1½ tons per week of aluminium produced from hydrate of alumina.

The process may be divided into three parts. First, the hydrate of alumina is converted into the double chloride of aluminium and sodium. This involves the manufacture of large quantities of chloride. Second, sodium is made from caustic soda. Third, the double chloride is mixed with cryolite (the native fluoride of aluminium and sodium) and metallic sodium and heated in a furnace, the result being metallic aluminium and common salt. To make one ton of aluminium the following ingredients are required:

Metallic sodium	6,300 lbs.
Double chloride	22,400 "
Cryolite	8,000 "
Coal	8 tons

To produce 6,300 lbs. of sodium are required:

Caustic soda	44,000 lbs.
Carbide, made from 12,000 lbs. of pitch and 1000 lbs. iron turnings	7,000 "
Crucible castings	2½ tons
Coal	75 "

To produce 22,400 lbs. of double chloride are required:

Common salt	8,000 lbs.
Alumina hydrate	11,000 "
Chloride gas	15,000 "
Coal	180 tons

To produce 15,000 lbs. of chloride are required:

Hydrochloric acid	180,000 lbs.
Limestone dust	15,000 "
Lime	30,000 "
Loss of manganese	1,000 "

It is thus apparent that to make one ton of aluminium there are used 100 tons of material for the production of the chlorine, 188½ tons for the production of the double chloride (not counting 6½ tons of chlorine gas), and 103 tons of material in producing the sodium, or 391½ tons in all, of which 263 tons are coal. It is not surprising that the metal should be expensive.

In the first process, the hydrate of alumina is mixed in a finely divided state with lampblack, charcoal, common salt and water in a pug-mill, and is then formed into short cylinders in a tile-pressing machine. These cylinders are dried and then exposed to a high temperature in the presence of chlorine gas. The double chloride of aluminium and sodium distils off, and is condensed in the form of a deliquescent, light-yellow substance of a very pungent odor.

The manufacture of the chlorine gas is carried on in the usual way by the action of hydrochloric acid on manganese dioxide at a moderately high temperature. The results are manganous chloride, water, and chlorine gas. The chloride is neutralized by limestone, and then milk of lime is added, the result being manganous oxide and calcic chloride. The oxide is further oxidized to the dioxide, its original condition, by air blown through it by means of an 80 H. P. engine.

The Castner sodium process is the most interesting. The old process included the intimate mixture of carbonate of soda and carbon, and their heating to a high temperature. The soda was volatilized, and parted with its oxygen to the carbon, and emerged as a metal. The process was carried on in small wrought-iron retorts, which wore out rapidly, and with the fuel required made the metallic product high in cost. Mr. Castner avoids this high temperature by devising a form of weighted carbon which, when mixed with fused soda, would not separate from it. This enabled him to substitute caustic soda for carbonate soda, and to conduct the operation in large vessels at a much lower temperature. The carbon used is an artificial carbide of iron made by coking an intimate mixture of finely divided iron and pitch, the result being a heavy metalliferous coke, which, when ground fine and mixed with fused caustic soda, blends intimately with it.

The process is carried on in cast-steel crucibles with covers provided with two pipes, one for receiving the charge and the other to conduct away the gases. Four furnaces with five crucibles in each can produce 2,000 lbs. of sodium in 24 hours, and the average life of each crucible is 750 lbs., or 125 charges. Six pounds of sodium are produced with each charge; the metal trickles from the condensers into iron pots, and is then remelted and cast into ingots, which are immersed in mineral oil to protect them from oxygen.

The aluminium is obtained from the mixture of the double chloride and sodium as follows:—The double chloride is broken into small pieces and mixed with cryolite, which latter is used simply as a flux. The sodium is cut into thin slices by a tobacco-cutting machine, and the three substances are mixed in a revolving box. They are then turned on to the hearth of a regenerative reverberatory furnace, where the charge melts. After three hours the melted slag is drawn off at an upper tapping hole, and then the metallic aluminium is run from a lower hole. The two furnaces at the works described have a capacity of 840 lbs. and 360 lbs. per day, or 1,200 lbs. in all.

This wonderful metal is only 2.65 times the weight of an equal volume of water and it retains its brilliancy under ordinary atmospheric conditions.

As compared with other metals, while aluminium is only about 2½ times the weight of water, iron is 7¾ times, copper nearly 9 times, gold 19½ times, and platinum 21½ times as heavy. Its electrical conductivity is eight times higher than iron and about equal to silver. Its elasticity and tenacity are equal to that of silver, and have been determined by Mr. W. H. Barlow at about 12 tons per sq. in. But weight for weight, its tenacity would be the same as that of high-class steel, or 36 tons per square inch; that is to say, bars of equal *weight* will carry the same load. It is very malleable or ductile, and aluminium 97 to 98 per cent. fine can be rolled into thin sheets or beaten into foil as thin as that produced from gold or silver.

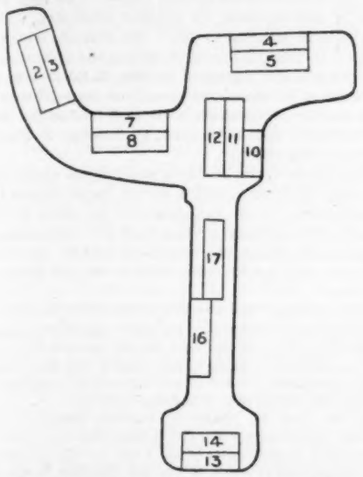
It alloys with most metals, and added to molten iron and steel it lowers the melting point and increases the fluidity of the metal, makes sharper castings, and is free from blow-holes, or similar imperfections arising from air bubbles and gases. Ferro-aluminium is an alloy of iron containing 10 per cent. of aluminium. This is used in gun-making in Russia by adding to the melted steel one part of the alloy to 80 of steel, with the result that the largest castings are completely free from air-bubbles, and have excellent mechanical properties. Aluminium-bronze contains 2½ to 10 per cent. of aluminium, with the effect of greatly enhancing the tenacity and rigidity of the copper; 10 per cent. alloys having sustained as much as 45 tons per sq. in with an ultimate extension of 25 per cent. Mitis metal, as made by Mr. Nordenfelt, is iron with from $\frac{1}{2000}$ to $\frac{1}{700}$ part, by weight, of aluminium added to it. The result is a metal so fluid and flexible that the author of the paper exhibited a wire brush cast by this process with wires and back in one piece, and yet the wires could be bent about like the softest iron wires.

Time Convention.—At the General Time Convention, held at the Hotel Brunswick, New York, this week, the date for changes in time-tables to go into effect was set at May 12.". The charges for interchanging cars was reduced from ¼ ct. to ⅛ ct. per mile and 10 cts. per day. President, H. S. Haines; Vice-Presidents, F. Wolcott Jackson and J. F. Harrahan; Secretary, W. F. Allen.

Comparative Hardness of Inside and Outside of Steel Rails.

An interesting technical question has recently been raised in a suit between Wm. Wharton & Co., Limited, and the Johnson Steel Street Rail Co., whether the ordinary steel rail has or has not an outer skin or shell which is harder and more durable than the main body of the interior. In the early days of steel rails, along about 1872, Mr. Wharton applied for and was granted a patent for making the bending cold, the channel or guard rails used on the sharp curves of street railways, claiming that in this way the skin of the rail was preserved, and the rail, as a whole, made more durable than if the rail were heated before bending, as was

to some extent the practice on account of the very short radius of these curves. The Johnson Company, on starting business some years ago, took out a license under this patent, paying the sum of $5 per ton for the privilege of bending steel rails cold. Recently, however, they have, by advice of counsel, refused to pay this license, taking the ground, not that the patent was invalid—for that, under the law, they cannot take after having become licensees—but rather standing on the technical ground that the product they were manufacturing was not in fact the article covered by the patent, viz., a rail with a hard outer skin, and that therefore, as they did not obtain the article, they were not bound to pay the license.



Rail Section, Showing Location of Test Pieces.

To test this question, Messrs. HUNT & CLAPP, of Pittsburg Testing Laboratory, were instructed to select from the stock on hand at the Cambria Iron Works a variety of specimens of the Johnson rails, and also some pieces of the Wharton groove rails; and to determine by any tests they could devise if any such difference in fact existed.

A series of tests were cut from these various rails in such a manner that the strips were alternately, in each series, from the metal at the surface of the rail, and further strips cut from the interior of it, each being about ⅛ in. thick, as per the sketches, which we do not reproduce, but which showed the test pieces distributed all over the sections. Various tests were made upon these strips, to indicate the relative hardness and density of the steel at the surface of the rail and in the interior as follows:

1. *Tests of Specific Gravity.*—The specimens cut for specific gravity were from strips ½-in. long, ⅛-in. thick, and ¼-in. wide, and were taken to represent as nearly as possible the steel upon the outside surface of the rail and the interior of the rail opposite to it, and the specific gravities were compared in 17 series or pairs of test pieces. These tests, as per Table *A*, show that the average of 17 tests taken from the inside of the various rails give an average density of 7.8300, and the average of 19 strips taken from the outside of the rail give an average of 7.8186, showing the average density out of the 36 specimens to be more dense in the inside of the strips by .0114. Grouping in series, 13 of the series show more dense interior specimens, while only 4 show more dense outside specimens. It is noted that small variance in specific gravity in steel indicates very large differences in the actual density and hardness of the steel, and that results varying in the second decimal place often show very remarkable difference in the quality of the steel. Strip No. 13 showed an abnormally high specific gravity, which, although it is put into the tabulated comparison, it is believed was due to some accidental cause, although the specific gravity result, 7.8005, is known to be correct in the report. With the result of this strip, and of the series 13 and 14 left out, a more marked difference will be shown between the inside and outside of the rail; the inside of the rail is more dense, at least, than the exterior of the rail, if not harder.

2. *An Attrition Test.*—An attrition test was made by taking strips cut from the outside and interior of the rail and rubbing the one specimen against the other. In one series of strips cut from the outside of the rail, the specimens were rubbed against each other, and the loss in weights noted after a given large number of strokes. Similar specimens, treated in exactly the same way with the strips cut from the interior of the rail, rubbing against each other, were tested. In this way tests were treated as per Table *B* of the 63-lbs. per yd. Johnson curved rail, which gave a total loss of 3⅛ oz. specimens from exterior, after 9,800 strokes, and, under the same treatment, strips cut from the interior of the rail lost only 0⅛ oz. Specimens were cut from a Johnson curved rail of 82-lbs. per yd., which, after 22,500 strokes, lost 23⅞ oz. Specimens cut in the same way, and under the same treatment, from the interior of the rails, lost only 6⅞ oz. Specimens cut from the outside surfaces of the Wharton curved rail, and rubbed against each other, lost 9⅜ oz.; whereas, specimens cut from the same rail, with surfaces from the interior of the rail rubbing against each other, gave a total loss of 5⅝ oz. In the case of each of the three series, those from the Johnson 82-lb., 63-lb., and from the Wharton rail, lost considerably more under attrition from the strips cut from the outside surfaces of the rails than those cut from the interior of the rails. A further test was made from strips of the 82-lb. Johnson curved rail, the rubber being with an interior face rubbing against a strip with an exterior face. After 5,125 strokes, the loss upon the rubber with the interior face was 1⅝ oz., and of the strip rubbed with an exterior face, a loss of 2⅝ oz.; again showing the most wear upon the strips cut from the exterior face of the rail. These attrition tests all indicated that the strips cut from the interior of the rail are harder than those cut from the exterior.

3. *Chemical.*—From Table *C* it would appear that the percentage of carbon and manganese is considerably reduced on the outside, due to the heating of the steel and the action of the oxygen of the air upon the exterior surfaces, over the amount of carbon and manganese contained in the steel in the interior of the rail. This amount, with steel rails having from 0.30 to 0.45 per cent. carbon, varied at least 0.023 per cent. in all cases, and in many cases considerably more. On this subject Messrs. HUNT & CLAPP further report that in other tests which they have made in the past it has been their experience that the percentage of carbon varies, with 0.30 to 0.40 per cent. carbon steel, from 0.07 to 0.08 per cent. on the interior from the exterior of the metal. The size of the steel ingot used at first, the rapidity with which it is rolled, the treatment in the heating furnace, etc., largely change these results; but the result of the average of very many tests made on this subject, with rolled steel, indicates the carbon to be at least 0.03 to 0.05 per cent. less on the exterior than the interior of the steel. The same remark applies with reference to manganese, which is, as the carbon, a hardener. The percentage often varies from 0.10 to 0.15 per cent. between the exterior and the interior of the rail, and, in the case of the tabulated report, varies from 0.04 to 0.10 per cent. Further examination of the analyses of steel shown in Table C will show that segregation of the impurities, especially in the percentage of phosphorus, is always to increase the percentage of phosphorus toward the interior of the steel. The action of this segregated to the center is as a hardener to the steel. The segregation in the case of the report, in one case was over .07 per cent., and amounted to .01 per cent. in many instances.

An attempt was also made to determine by a grinding test whether there was any difference in hardness between inside and outside, but the result will be seen from Table D to be very lawless, indicating that other causes than the relative hardness of the metal, presumably slight differences in the condition of the surface of the wheel, had much to do with the result. There were 7 cases in which the outside pieces lost the most, and 7 cases in which the inside lost the most; but, owing chiefly to one or two very abnormal results, notably Nos. 25 and 22, the average abrasion from the inside pieces was slightly greater than from the outside. A tendency can be detected in Table D to show the outside pieces hardest in the pairs of samples which lost least (i. e., in the best rails), but the table is too lawless to found any conclusions on.

As a net result of the investigation Messrs. HUNT & CLAPP conclude:

For the reasons shown by the tests above mentioned, which only confirm a very considerable previous experience with the different quality of the exterior and interior surfaces of rolled steel bar, we would state it to be our judgment that there is a very considerable increase, both in density and hardness of the metal, in the interior of sections of rolled steel over the metal which is upon the exterior surfaces.

Table A. Tabulated Report of Specific Gravity Tests for Johnson Steel Street Rail Co.

Specimen Number.	Location of Specimen.	Specific Gravity.	More Dense Inside.	More Dense Outside.	% Carbon.	% Manganese	% Phosphorus.	% Sulphur.
2.	82# Johnson Rail Inside	7.8412						
3.	" Outside	7.8071	.0341					
4.	" "	7.8167						
5.	" Inside	7.8514	.0347					
7.	" Outside	7.8301						
8.	" Inside	7.8396	.0095					
10.	" Outside	7.7878						
11.	" Inside	7.8166	.0305					
12.	" "	7.8200						
13.	" Outside	7.8065						
14.	" Inside	7.8138		.0857				
16.	" Outside	7.8001						
17.	" Inside	7.8095	.0094					
18.	Wharton Rail #1 Outside	7.7854			0.48	1.14	0.088	0.054
20.	" Inside	7.8252	.0398		0.45	1.08	0.086	0.057
21.	" "	7.8089			0.43	0.91	0.168	0.064
23.	" Outside	7.8016	.0073		0.27	0.88	0.088	0.062
25.	" "	7.7735						
26.	" Inside	7.8264	.0529					
27.	" Outside	7.7773						
28.	" Inside	7.8065						
29.	" "	7.8083	.0226					
30.	" Outside	7.7740						
31. X	" "	7.8061						
32.	63# Johnson Rail "	7.8567			0.34	0.92	0.110	0.055
33.	" Inside	7.8514	.0097		0.36	0.86	0.115	0.055
34.	" Outside	7.8483						
35.	" Inside	7.8167		.0316	0.40	0.82	0.134	
37.	" Outside	7.8337						
38.	" Inside	7.8698	.0361					
39.	" Outside	7.8612						
40.	" Inside	7.8218		.0394				
41.	" "	7.8390						
42.	" Outside	7.8308	.0082					
43.	" "	7.8481						
44.	" Inside	9.8472		.0009				
Average of 17 More Dense Inside		7.8300						
Average of 19 More Dense Outside		7.8186	.0114					

13 Series show more dense interior specimens.
4 Series show more dense outside specimens.
Specimens numbered 2 to 17 inclusive, from one rail.
Specimens numbered 18 to 31 inclusive, from one rail.
Specimens numbered 32 to 44 inclusive, from one rail.
Specific gravities referred to water at 4° Centigrade.

PITTSBURG TESTING LABORATORY
HUNT & CLAPP.

Table B. Report of Attrition Tests of Specimens Cut from Exterior and Interior of Rails.

Specimens were rubbed with a stroke of 9¼ ins., and with a superincumbent weight of 110 lbs. in each case on the rubber, and at the rate of 25 strokes per minute for the time mentioned below in each test. The rubber and strip rubbed were the same size.

Specimens cut from *outside surfaces* rubbing against each other, of blow 281,800. A rail of 63 lbs. per yd., Johnson Curved Rail. Time, 6h. 32min. or with 9,800 revolutions or strokes.

Weight of rubber originally	47 15-16 oz.	
" " " after being worn	45 12-16 "	Loss, 2⅛ oz.
" " strip rubbed originally	47 15-16 "	
" " " " after being worn	46 6-16 "	Loss, 1 9-16 oz.
		Total loss, 3 11-16 oz.

Specimens cut from same rail with surfaces *from interior* of the rail rubbing against each other, and for the same time and number of strokes.

Weight of rubber originally	45⅞ oz.	
" " " after being worn	45⅜ "	Loss, 0⅛ oz.
" " strip rubbed originally	45 13-16 "	
" " " " after being worn	45⅜ "	Loss, 0 7-16 oz.
		Total loss, 0 15-16 oz.

Specimens cut from *outside surfaces* rubbing against each other, of blow 281,838. A rail of 82 lbs. per yd., Johnson Curved Rail. Time, 15h., or with 22,500 strokes.

Weight of rubber originally	57 1-16 oz.	
" " " after being rubbed	45 1-32 "	Loss, 12 1-32 oz.
" " strip rubbed originally	56 9-16 "	
" " " " after being worn	44¾ "	Loss, 11 13-16 oz.
		Total loss, 23 27-32 oz.

Specimens cut from same rail with surfaces *from interior* of the rail rubbing against each other, and for the same time and number of strokes.

Weight of rubber originally	57 15-16 oz.	
" " " after being worn	54⅝ "	Loss, 3 9-16 oz.
" " strip rubbed originally	57 9-16 "	
" " " " after being worn	54 11-16 "	Loss, 2 14-16 oz.
		Total loss, 6 7-16 oz.

Specimens cut from 82 lb. per yd., Johnson Curved Rail, it being the same rail as mentioned above, of blow 281,838 and having the same weight of 110 lbs. on the rubber, and same speed of 25 strokes per minute for 3h. 25min. or 5,125 strokes, *the rubber* being so prepared that *an interior surface* of the rail on it *rubbed on an exterior face of the rail of the strip rubbed.*

Weight of the rubber *with interior face* originally	34 3-16 oz.	
" " " " after being worn	32 9-16 "	Loss, 1⅝ oz.
" " " strip rubbed with *exterior face* originally	54 9-16 "	
" " " " " " " after being worn	51 16-16 "	Loss, 2⅝ oz.

Specimens cut with *outside surfaces* rubbing against each other, of a Wharton curved rail, with weight of 110 lbs. on the rubber, and with a stroke of 25 per minute for 10 hours time, or with 15,000 strokes.

Weight of rubber originally	45⅝ oz.	
" " " after being worn	41¼ "	Loss, 4¼ oz.
" " strip rubbed originally	45 9-16 "	
" " " " after being worn	40 3-16 "	Loss, 5 6-16 oz.
		Total loss, 9 9-16 oz.

Specimens cut from *same rail* with surfaces from *interior of the rail* rubbing against each other.

Weight of rubber originally	52⅝ oz.	
" " " after being worn	49⅜ "	Loss, 3¼ oz.
" " strip rubbed originally	51¼ "	
" " " " after being worn	48⅞ "	Loss, 2⅜ oz.
		Total loss, 5⅝ oz.

Table C. Tabulated report of Analyses for Johnson Steel Street Rail Co.

Lab'y No.	Specimen.	Carbon %	Mangan'se %	Phospho-rus. %	Sulphur. %	Silicon. %
5181	Wharton, No. 1—Outside.	0.48	1.14	0.088	0.054	0.008
80	" 1—Inside.	0.45	1.08	0.080	0.037	0.011
82	" 1—Center.	0.43	0.91	0.108	0.064	0.006
91	" 1—Under face.	0.46	1.10	0.087	0.062	0.021*
95	" 3— "	0.31	0.89	0.073	0.059	0.015*
5210	" 3—Outside.	0.30	0.81	0.065	0.058	0.018
11	" 3—Inside.	0.30	0.80	0.069	0.062	0.023
5196	" 4—Outside.	0.43	0.94	0.071	0.055	0.020
97	" 4—Under face.	0.42	0.95	0.075	0.053	0.020*
85	Heat, No. 281,830, Outside. Dust from Rubbed specimens.	0.30	0.92	0.113	0.055	0.116
5200	" 281,830—Outside.	0.30	0.96	0.113	0.050	0.018
03	" 281,830 Inside. Dust from Rubbed specimens.	0.32	0.92	0.121	0.055	0.023
16	" 281,830—Center.	0.35	0.96	0.103	0.062	0.029
06	" 281,830 Under face. Outside Scale removed.	0.36	0.98	0.104	0.057	0.023
5199	" 281,887—Outside.	0.30	0.90	0.118	0.060	0.012
5208	" 281,887 Under face. Outside Scale removed.	0.30	0.92	0.130	0.055	0.023
17	" 281,887—Center.	0.33	0.98	0.116	0.057	0.019
5192	" 281,880—Outside.	0.34	0.92	0.110	0.055	0.019
93	" 281,880—Inside.	0.36	0.86	0.115	0.055	0.020
5200	" 281,880—Center.	0.40	0.82	0.134	0.063	0.023
04	" 281,838—Outside.	0.33	0.94	0.130	0.063	0.023
5198	" 281,838 Under face. Outside Scale removed.	0.28	0.88	0.109	0.055	0.012
5218	" 281,838—Center.	0.24	0.97	0.128	0.064	0.023
05	" 281,845—Outside.	0.25	0.92	0.125	0.063	0.023
07	" 281,845 Under face. Outside Scale removed.	0.34	0.98	0.122	0.062	0.023
15	" 281,845—Center.	0.29	0.96	0.129	0.051	0.023

*Scale removed from outside.

NOTE.—All rails from Nos. 5185 to 5209 weighed 63 lbs. per yd., and from No. 5204 to end they weighed 82 lbs. per yd. The 63 lb. rails were of the Cambria section No. 140, and the 82 lb. rails of the Cambria No. 137.

Table D. Grinding Tests of Steel Rails made at Brown & Sharpe's Shops, Providence, R. I., for Johnson Street Rail Co., Johnstown, Pa.

Tests were made on a "Universal Grinding Machine," stroke 2 ins., about 150 strokes per minute, with a pure corundum wheel, which was faced off with a diamond after each test, to prevent glazing. The piece to be tested was held against the face of the wheel with a uniform pressure of 15 lbs. The grinding lasted exactly 20 seconds in each case. The number of the pieces refer to numbers on sketches herewith, or others similarly situated. In testing pieces 19 and 29, the machine worked slowly owing to the driving belt of the stroke-motion having become worn. It broke after 29 and before the next piece was put in. This does not appear to have influenced the results, however. The *scale* was faced off of all outside pieces before testing.

Outside pieces	*P. c. loss*	*Inside pieces*	*P. c. loss*	*Excess of loss on*	
No.		No.			
3	2.13	5"	1.00	Outs. 1.13	
4	.00	8	1.00	Ins.	1.00
7	2.20	11'	2.07	Outs. 0.13	
10'	1.53	11" Dup.	1.13	Outs. 0.40	
10" Dup.	1.27	19 (slow)	1.33	Ins.	0.06
18	2.81	20	3.20	Ins.	0.39
23	1.40	21	2.20	Ins.	0.80
25	2.00	22	5.00	Ins.	3.00
27	2.53	24	2.07	Outs. 0.46	
30	2.40	26	3.73	Ins.	1.33
×	1.87	28	3.13	Ins.	1.24
32	2.00	29 (slow)	1.27	Outs. 0.73	
34	1.07	33	.90	Outs. 0.17	
42	1.20	35	1.00	Outs. 0.20	
		36	1.40		
		41	3.87		
Av. 14, outside	1.73⅝	Av. 16, inside	2.30⅝	Total	3.22 7.82

The Pintsch Oil-Gas Plant.

Except for the advent of electric lighting, the lighting of cars by gas would by this time, we believe, be making as rapid progress as is steam heating toward universal use, and as it is, it is making decided progress, and it is by no means clear to us that it will not continue to be for many years to come the successful rival of electricity, even if the difficulties in respect to maintenance of storage batteries and other causes, which now impede the rapid progress of electricity, be done away with. One thing is certain, that gas furnishes a light better, cheaper, and safer than any other, being practically absolutely safe, experimental efforts to produce explosion having failed. The best system of gas lighting, by general admission, which has been introduced so far is the Pintsch, which is rapidly increasing in use on thousands of European cars (11,422 cars equipped in 1883, 27,465 in 1888, an increase of 16,043 in 5 years) and on some 563 cars in this country, the system being standard on the Erie, West Shore, and New York, Providence & Boston roads among others.

Nevertheless, the broadest and longest experience has been in Europe, and a recent paper before the Institution of Civil Engineers* by an officer of the Caledonian Railway gives a very full practical account of the whole process, which will be read with interest and profit, and which we condense as follows:

THE MANUFACTURE AND COMPRESSION OF THE GAS.

Manufacture.—Generally, the gas is made from once-refined paraffin oil in cast-iron retorts, the tar is removed, the gas condensed, washed, and purified, and then passed to the gasometer, from which it is drawn by compression pumps, and forced into cylindrical holders.

At the Cook St. (Bridge St. Station, Glasgow) Gas-Works, which supply the Caledonian Railway,† the arrangement is as follows (Figs. 1 and 2):—In the retort-house there are two sets of benches that can be worked alternately, also an upright boiler for supplying steam to a duplicate set of compressing pumps. In the purifying-house are the condensers, washer, a double set of purifiers, and the meter; while the storage cylinders are in a separate house at a short distance.

The retorts, Figs. 3, 4 and 5, are Ω-shaped cast-iron tubes, 5 ft. 10 ins. long, and 10 ins. wide, placed one above the other, the lower one resting its whole length on a firebrick sole. The flame from the furnace passes round both sides of the lower tube, over the top, and there engages with the upper tube, finally reaching the flue or combustion chamber. Thus the flame plays directly upon all parts of the tubes, not unduly heating some parts and others partially. The flues are built of ordinary firebricks. Both ends of the tubes are fitted with mouthpieces or covers, admitting of thorough cleaning.

The oil is pumped from barrels into a 15-gall. cistern on the top of the retort-bench, which thus maintains a constant head and a steady flow. It enters the upper retort, Fig. 4, in a thin, continuous stream from a micrometer cock, through a siphon pipe, and falls upon an iron tray on the bottom of the retort. This prevents the cold stream of oil coming in direct contact with the hot retort, and thus reducing its temperature. Here it is partially vaporized, and, passing through the tube, descends to the lower tube, where it encounters a higher temperature, rendering it permanent or "fixed." The object of this is to insure that every portion of the vaporized oil shall be acted upon by the highest temperature, without undue exposure to the heated surface of the retort. As the gas leaves the retort, it is largely mixed with tarry and other vapors, which give it the appearance of smoke of a more or less dense nature, in proportion to the quantity of such matters present. It now passes through a tar pit or hydraulic main, filled with water, where the first separation of the tarry matter is effected. The condensers consist of two vertical cylinders, through which the gas passes, entering at the bottom of one and passing up through it, and then down through and out at the bottom of the other, the effect of

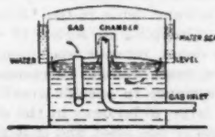


Fig. 7. Section of Washer.

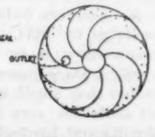


Fig. 8. Plan of Underside of Tray.

*"The Manufacture of Oil-Gas on the Pintsch System, and its Application to the Lighting of Railway Carriages," by GILBERT MACINTYRE HUNTER, Assoc. M. Inst. C. E. Another paper on "Compound Oil-Gas and its Application," by ARTHUR AYRES, was published by Inst. C. E., 1887-8.

†The company has another gas-works at Perth for supplying the northern section of the railway.

which is to condense the tar. The gas now passes to the washer (Figs. 7 and 8).

The inlet pipe is vertical, with a tray over it having curved arms or "spreaders" on the under or water side. The gas on entering is turned downward by the tray, and driven through the water in a circling fashion by the spreaders; it finally passes out of the water, through a series of perforations round the edge of the tray, into an upper or gas chamber, and thence to the purifiers. This washing process assists in removing the brownish or smoky appearance of the gas, and arrests and deposits all the tar which may pass with it. The quantity of tar in the gas varies with the temperature maintained within the retorts, and also with the quantity of oil run into the retort. There is also a great variation in the quality of tar given off by different oils. Some classes yield very light "thin" tar, which comes out at the overflow in the washer, being lighter than the water; while other classes give off heavy tar, which sinks to the bottom, and is drawn off to the tar tank. Both the condensers and the washer are provided with siphons to remove the tar. Although the gas has been undergoing purification, so to speak, in the successive stages through which it has passed, it is now submitted to a final and thorough purification for the removal of sulphur compounds, carbonic acid, and sulphuretted hydrogen. The purifiers are arranged in a double set, and by means of a four-way valve the gas can be made to pass through either one or other, or both. The purifying material consists of slaked lime and sawdust in the proportion of 2 to 1, which is renewed weekly. It is spread evenly about 2 ins. deep over a perforated tray, in the same manner as a coal-gas purifier. The gas now passes to the meter, and thence to a gasholder, which has a capacity of 1,700 cu. ft.

At night the main valve is shut, the dampers are closed, and the covers over the tar pit are removed, to allow the gas in the pipe to escape; the manhole covers are also removed, and the tar and pitchy matter drawn off. The mouthpieces are next taken off, the retorts cleaned out, and the covers replaced; the fires are drawn, and afterwards banked for next morning. The fires are kindled with coal and dross; thereafter they are wholly maintained with coke, which gives much better results than coal. After they have been kindled for about an hour and a half, the oil is turned on. The proper heat has not been obtained yet; but, owing to the demands on the work, longer time cannot be spared, so that the yield of gas per gallon of oil is comparatively small for the first hour or so. When the retorts are irregularly heated, there is a large increase in the quantity of tar; while, if they are overheated, the distillation is attended with a separation of carbon in the form of soot, and if insufficiently, there is deposited in the retort a carbonaceous substance resembling coke, in addition to an abundant production of tar. The best temperature is a bright cherry-red heat, verging on white; then there is only a small quantity of carbon or soot.

A high illuminating gas* can be produced when the yield is small; and conversely, with a high quantitative yield, the light-giving quality of the gas will be diminished. A fairly good yield, which can be obtained in every-day practice, varies from about 70 to 85 cu. ft., or 18,480 to 22,440 cu. ft. per ton of oil, of 50 to 60 candle-power gas. Mr. J. B. MACARTHUR has shown† that a yield of 120 cu. ft. per gall. was only equal to 40 candles, and that when the yield reached 158 cu. ft. (which was at a bright orange heat) the candle-power fell to 20 to 25.

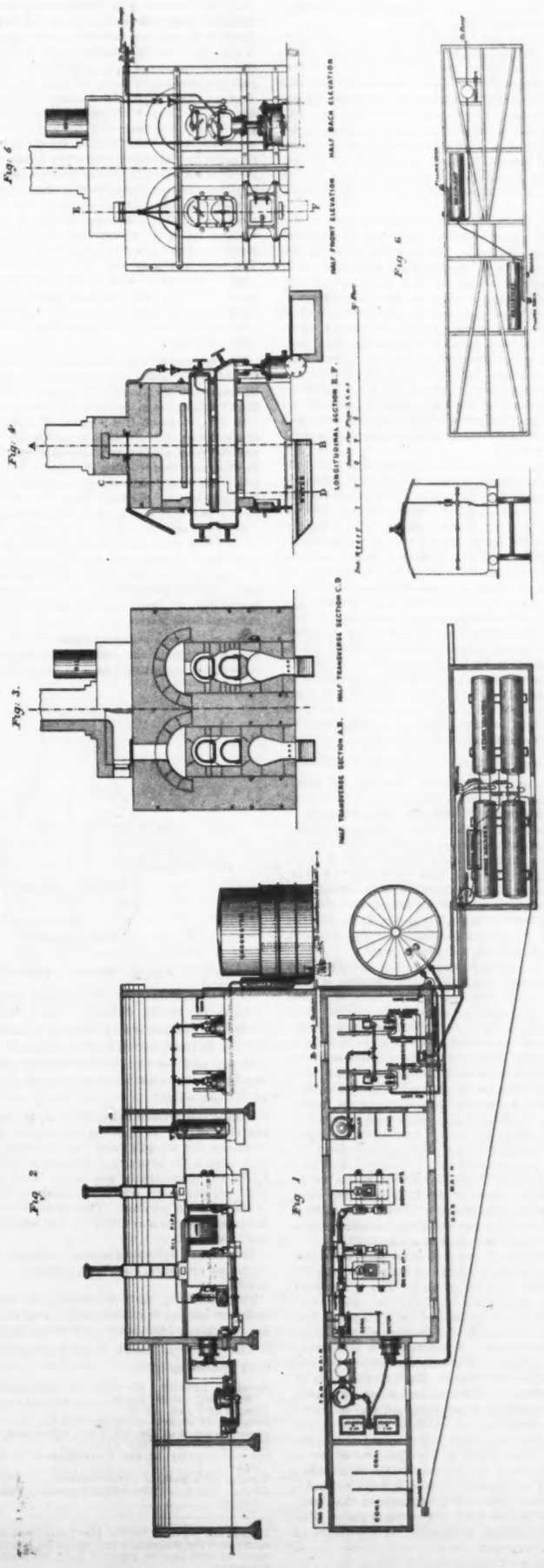
No. 1 bench was worked continuously for 14 weeks in the winter of 1887—8, during which time 8,294 galls. of oil were distilled, yielding 669,850 cu. ft. of gas, or an average of 80.76 cu. ft. per gall. This is the longest time they have been worked without requiring a renewal of the retorts or the flues. They usually last about 10 or 11 weeks.

During the year 1886 the average yield per gallon of oil was 72 cu. ft. of gas, or 19,008 cu. ft. per ton of oil; and, for the year 1887, 81.22 cu. ft., or 21,442 cu. ft. per ton of oil. These are very satisfactory results from a work where resources are taxed to the utmost. A certain quantity of gas must be manufactured each day, and at times it is difficult to supply the demand; therefore no time can be spared in allowing the oil to be "drawn" to its utmost, as it might be, were there time. Dr. MACADAM, F. C. S., while conducting some experiments, found that the apparatus yielded from the gallon of oil, on the first occasion 90.70 cu. ft., of gas of 62.50 candle-power; on the second occasion 103.36 cu. ft. of 59.15 candle-power, or an average of 97.03 cu. ft. of 60.82 candle-power gas. In both cases the firing of the retorts was moderate, though in the second trial greater care was taken to secure uniformity of heat, and the oil was run in more slowly, so that there was more thorough splitting up of the oil into permanent gas.

Approximately it takes about 5 tons of coke, 4½ tons of dross, and 10 cwt. of coal to make 100,000 cu. ft. of gas, or about 4.46 lbs. of fuel per cu. ft. of gas. This includes kindling and getting up the heat in the retort.

*Transactions of the Institution of Engineers and Shipbuilders in Scotland, vol. xxx. p. 239.

†Journal of the Society of Chemical Industry, vol. vi. 1887, p. 811.



Pintsch Oil-Gas Lighting Plant, Caledonian Railway.

The cost of making the gas, including oil, fuel, wages repairs, etc. is $1.58 per 1,000 cu. ft.

Compression.—The gas is drawn from the gasometer by compression pumps, and forced into cylindrical store-holders at a pressure of 150 lbs. per sq. in., or 10 atmospheres. The compression is effected by a double-acting pump,* which has a ram-diameter of 6¾ ins., compressing the gas to 60 lbs. per sq. in., and a diameter of 4 ins., compressing to 150 to 180 lbs per sq. in. Although the holders are tested to a pressure of 180 lbs., or 12 atmospheres, they are seldom charged to more than 150 lbs. The compressing cylinders are kept cool by a jet of water running round them. These pumps are worked week about.

The freezing cylinder retains in cold weather, in the shape of ice, any water particles that may be absorbed by the gas in the gasometer. These water particles are much impregnated with carburetted hydrogen, and, when thawed, may be drawn off by a cock. As a rule, there is never more than a trace of this. The cylinder cools the gas and serves the purpose principally of a reservoir, from which the pumps can draw without directly affecting the gasometer. In fact, it serves the same purpose as a gas-bag to a gas-engine. In the engine-room there is a suction-gauge, for showing if the pumps are drawing the gas regularly. There are relief cocks on the pumps, which shut off the high-pressure gas from the cylinder valves after the store-holders have been charged, and the column of gas in the pipe is allowed to pass back into the gasometer.

The store-holders are mounted on trestles, each pair being connected underneath the front end by a small pipe which leads to a recipient encased in a box of sawdust for the hydrocarbon, from whence it is drawn off into a drum The pressure of the gas in the holders drives out the hydrocarbon into the recipient, and thence to the drum; but, as a certain quantity of gas always passes with the hydrocarbon into the drum, provision is made for this gas to pass from the drum into the gasometer. The hydrocarbon being the principal constituent of the gas, any diminution affects the illuminating power of the gas On an average, it loses fully 5 candle power by compression. The compression causes the deposit of the hydrocarbon at the rate of about 1 gall. per 1,000 cu. ft., of gas. It gives off an inflammable vapor at a temperature of less than 45° Fahr. It is, accordingly, rather a dangerous substance to work with, and is generally drawn off from the drum into smaller ones for transmission to manufacturing chemists, on a dull, moist day.

APPLICATION TO THE LIGHTING OF RAILWAY CARRIAGES

From the works to Bridge St. Station (¼ mile). and also to Central Station (½ mile), pipes are laid so that trains can be charged with gas while standing in either of these stations. A pipe is also laid to a carriage shed (½ mile), and carriages can be charged there before being taken out. Filling cocks are placed every 34 ft., so that a carriage may come near each cock; a 30-ft. length of india-rubber hose is attached to the filling cock on the carriage, and the pressure gauge records the volume of gas supplied. It takes 3 minutes to couple the hose and charge a standard carriage carrying 6 lamps, if they be empty, but this is seldom the case.

Fig. 6 shows the general arrangement of the pipes and fittings on an ordinary carriage. Each carriage is provided with one or two recipients or cylinders, of a size proportionate to the number of lamps it carries. The recipients are made of ⅜-in. steel plate carefully bent, The joints are both riveted and soldered, and the flanged ends are then fitted in, fastened by screws, and soldered over. The cylinder is afterwards tinned both inside and outside, so that it is perfectly gas-tight. It was at one time imagined that dangerous explosions might result from the presence of so much gas under each carriage in the event of a railway accident. An experiment sufficiently proved the comparatively harmless nature of the small volume of gas enclosed in the recipient, and that the gas can escape only through external power or an accident. [We omit details of it.—ED.] This has been confirmed in several cases where a broken tire made a hole in the recipient, the gas escaping harmlessly into the air before the train had come to a standstill.

The size and position of the recipients vary with the different modes of under-framing, and also the number of wheels for each type of carriage. For a standard carriage they are fixed longitudinally to the under-framing, one on each side, and connected by a pipe. The filling cocks are fixed outside the framing on each side, as also the pressure-gauge. A regulating or governing valve reduces the pressure of the gas after it has left the recipient on its way to the lamps. The valve consists of a cast-iron pan 12 ins. in diameter and 6 ins. in depth. The upper part is closed by a membrane of specially prepared leather, to the center of which is fastened a rod connected at its lower end with a lever controlling the regulator-valve. This lever is also controlled by a double-leaf spring acting in opposition to the membrane; and by this means the regulator-valve is rendered independent of the movement of the carriage, so that accidental extinction of the light never takes place. The gas passes the valve, which is adjusted for a pressure of only that due to a ¼-in. column of water; and when the pressure under the membrane is reduced below this, the valve is closed, and the process of opening and closing is repeated until a balance between the admission and the consumption is obtained. These regulators are adjusted according to the number of lamps which they will supply; thus a four or five-lamp regulator is adjusted to 30 m.m., or 1 7/16-in.* From the regulator a low pressure-pipe is carried up the end of the carriage on to the roof, and connects the several lamps. On the end of the carriage there is a by-pass valve, worked by a draw-rod, by which, in the event of a train standing empty at a station, there being no occasion for the gas burning, the lights can be shut down without being extinguished. There is likewise a concussion-box, which always contains a supply of gas, so that, in the event of a sudden pull of the draw-rod, the lights are not extinguished, as they otherwise might be. The pipe is simply cut; both ends are closed, and the pipe is perforated with a few holes through which the gas escapes, and fills the box, making it a gas-chamber, from which it is again drawn off. Above this is the main cock, which shuts off the gas from, or admits it to, the whole carriage.

The recipients are charged to 6 atmospheres (90 lbs.) for thirty-six hours' burning; and no carriage is allowed to leave the terminus with a lower indicated pressure than 2 atmospheres, or twelve hours' burning.

In Fig. 9, which is a section of a standard lamp, the arrows show the direction in which the foul air escapes, and the fresh air enters to support combustion. It will be observed that sudden gusts of wind cannot directly affect the light; that, the globe being perfect inside, the opening of the carriage-door has no effect upon the light; and that sparks from the engine or other matter cannot get into the inside of the lamp. The rich nature of the gas renders the adoption of a special burner necessary; because, the greater the illuminating power of a gas, the smaller will be the consumption to maintain a light of given brilliancy. The burner, a small fish-tail, made of "speckstein" or steatite, gives a well-shaped, steady flame.

The gas being a permanent gas, it can remain for any length of time in the recipients without deteriorating, either in illuminating power or in pressure.

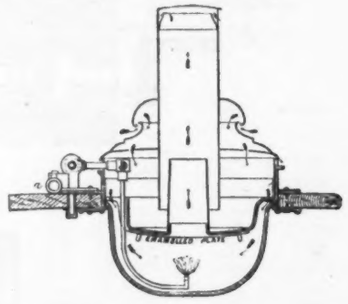


Fig. 9. Section of Lamp.

[The lamps now in use in this country are improved in many details from that illustrated, although the general principle is the same. They have 4 burners instead of 1, hang down from the ceiling, and (in the newest forms) glass globes on top to prevent casting shadows on the head lining of the car.—ED.]

Taking the present price of oil as 46 cts. per gall., and the cost of gas as $1.58 per 1,000 cu. ft. less the residual products, the oil will burn for 184 hours, while the gas will burn 1,333 hours, and the cost would be 0.25 ct. and 0.1189 ct. respectively per hour. This is a saving of 0.1311 ct. per hour, which for 1,000 cu. ft. represents a saving of 110.29 per cent. The value of the residual products, hydrocarbon and tar, for 1887, amounted to 26½ cts. per 1,000 cu. ft.

The cost of fitting a standard carriage with six lamps, including recipient, regulator, gauges, valves, pipes, etc., is $165.

The following tests to determine the illuminating power of the gas were undertaken with the view of showing the value of the gas as used in the carriages:

The gas was taken from a recipient charged to over 10 atmospheres:

Specific gravity of the oil (Clippen's "Straiton") at 60° Fahr.	848.2
Weight of 1 gall. of oil	8.482 lbs.
Number of gallons of oil per ton	264
Flashing point of the oil, Fahr. (close test)	268°
Firing point of the oil, Fahr	294°
Specific gravity of the hydrocarbon at 60° Fahr	845.2
Weight of 1 gall. of hydrocarbon	8.452 lbs.
Firing point of the hydrocarbon, Fahr. (below)	45°

GAS.

	min.	mins.	mins.	mins.
Time of test	0	15	30	45
Temperature, Fahr	63°	63°	64°	64°
Pressure of the gas in tenths of an inch	7.5	7.75	7.25	7.5
Reduction in pressure, from 7.35 to 5.75 atmospheres		1.60		
Gas consumed per hour, cubic foot		0.74		
Illuminating value of the gas as taken by photometer, and reckoned in standard sperm candles consuming 120 grains per hour	8.25	8.25	8.0	8.0
5 cu. ft. are equal in intensity to 55.7 candles				
Illuminating value of 1 cu. ft. of the gas in grains of sperm		1,336		
Illuminating value of the gas from 1 gall. of oil in lbs. of sperm		15.36		
Total illuminating value of the oil yielded by 1 ton of oil, and given in lbs. of sperm		4,055		
Volume of oil running into each retort per half minute, oz		6¼		
Volume of gas yielded by each retort per minute, as shown by the meter, cubic feet		8		
Total volume of gas yielded per hour by the two retorts, cubic feet		960		
Average yield per gallon, cubic ft.		80.48		
Which, calculated to the ton of oil, gave cubic feet		21,246.72		

The Pintsch process in this country is controlled by the Safety Car Heating & Lighting Co., of 160 Broadway, New York, which undertakes to erect plants and furnish gas at a fixed price.

The Resurvey of South Amboy, N. J.

BY GEO. HILL, C. E.

In vol. XIII. of ENGINEERING NEWS, p. 189, a correspondent asks a question that has puzzled city surveyors for the past fifty years. No doubt, and so far as the text-book goes in answering, it must puzzle them still. It is, How shall I locate a lot in a tract that has been laid off in blocks and lots, when the actual dimensions do not agree with that given on the recorded map? In the editorial comment on the communication an answer is given for the burnt district in Chicago, and in a subsequent article, same volume, p. 290, *et seq.*, it is very fully answered for the 23d and 24th wards of New York City.

It is the purpose of this article to give an example of the application of a similar principle, which is of a more general character. In 1834 certain parties in Middlesex county, N. J., formed a trust for the better disposal of lands owned by them on the shore of Raritan bay, just south of the terminus of the Camden & Amboy R. R. To carry out this project, they conveyed to JAS. P. THOMAS and ALEX. CATHERAL three tracts of land comprising about 245 acres, by the following descriptions:

A. Beginning at a stake standing on the beach, and in the line of lot No. 3 *A*, and running thence: 1. S 63° W 64.60 chains to a marked white oak sapling. 2. N 15° W 8.94 chains to the branch turnpike. 3. Down the west side of the same 4.92 chains. 4. N 63° E 61.00 chains to the Bay shore. 5. Down the same the several courses thereof to the leg.

B. Beginning at a stake standing at the east side of the branch* turnpike road, and at the northeast corner of lot sold to Guy Wells, thence along the said turnpike. 1. S 48° W 8.58 chains. 2. N 15° W 20.00 chains to line of Lewis Hausell's land (Tract *A*). 3. N 63° E 64.00 chains to the bay shore. Then beginning again at the above beginning, and running 4. S 15° E 4.40 chains. 5. N 65. E 50.00 chains to the bay shore. 6. Up the same the several courses thereof to the end of course 3.

C. Beginning at a stake standing at the water's edge on the shore of Raritan bay, being the northeast corner of landslate of D. Johnson, deceased, and thence running: 1. S 63° W 49.60 chains to a stake in the south side of the road to the widow Morgan's, and in the corner of a lot purchased by Guy Wells. 2. N 15° W 11.15 chains to a stake. 3. N 65° E 50.00 chains to the bay shore. 4. Southerly along the same to the beginning.

The general character of the ground is shown on the map, which is taken from the contour map of the resurvey, corrected from reliable data so as to eliminate changes caused by subsequent improvement.

Messrs. THOMAS & CATHERAL employed a surveyor to subdivide these tracts, and as a result, in June, 1835, a map was filed in the clerk's office of Middle-

* Revue Générale des Chemins de Fer, 1882, p. 127.

* All the pipes between the recipients and the filling cocks and the regulator are under high pressure, and are made of best special pipe of ⅜-in. bore and ½-in. outside diameter.

* Mistake in deed. Should read "main."

sex County, N. J. Signed by J. P——, Jr., Surveyor, giving a layout similar to that shown in dotted lines on the map, with no other dimensions than those shown; the dimensions enclosed in brackets were put on in red ink, and a foot-note read "N. B. The red figures are laid down by a scale."

Since then all conveyancing has been done with reference to this map, beginning with an auction sale of the lots in the entire tract, at which sale all conveyances of blocks were made on the basis of the number of lots of 2,500 sq. ft. which they contained.

An examination of the data on the map will show:

1. The "red figures" evidently were put in from scale, since they are not the correct lengths for lines joining (2) converging straight lines.

2. No data is given by which to determine the lengths of blocks east of Rosewell St. or west of Feltus St.

3. No data are given to locate the turnpike west of Broadway.

4. Catharine and Gordon Sts. must be offset 5 ft. south, when crossing the turnpike, to agree with the figures, although they are drawn continuously. We also find:

5. The original map miserably drawn and only the regular blocks subdivided.

6. Gross inaccuracies existing between the lengths of lines measured on the ground and scaled from the map, too great to be accounted for by shrinkage or poor scaling.

7. No monuments referred to on the map or in the deeds.

8. No similarity between the official return of the layout of the turnpike, made in 1818, and the layout shown on the map.

Subsequent litigation and investigation evolved the following:

a. The entire tract was surveyed and all block corners staked; no one, however, could testify to having seen any of these stakes except along the turnpike and Broadway, and although all of the land was more or less covered with timber and underbrush no one remembers having seen any evidences of cleared lines.

b. J. P.——Jr. testified that he always used the "red figures" as correct when taking out lots; that he usually began at a black oak tree 15 ft. east of the west line of Broadway, and in the north line of the whole tract (known as the company's line), and other witnesses testified to having seen him use the center of this tree.

c. A. J. D——, a surveyor, testified that he began to make locations in this tract in 1845, and then found gross inaccuracies, and it was not until about ten years later that he made a practice of locating lots there; then he placed a stone at the northeast corner of Broadway and George St., which he sometimes claimed was located in the place of one of the original stakes, but oftener that it was located from an original stake about 500 ft. away. This stone he used as a starting point for his surveys, and it was about 7 ft. south of its proper location measuring the exact map distances from the company's line.

d. J. P.——, Jr., made two locations of a lot 1,000 ft. south of his beginning point, and differed in the two between 5 and 6 ft.

e. In 1861, J. P.——Jr. made a location of a lot 50 ft. from his beginning point; the stakes he set were driven down, and stones placed over them, and one of these stones was unearthed 6 ft. below the present grade of the street.

f. In 1865 A. J. D—— made a location of the intersection of the west line of Broadway with the company's line, which differs less than 1 in. from the location of the same point made from the stone noted in *c*.

g. The south line of the tract, known as Conover's line, is marked by a fence its entire length, nearly straight and undisputed.

h. In 1866 an agreement was entered into between the Camden & Amboy R. R. Co. and the property owners on the north side of Augusta St., adopting as the boundary between their respective properties, a line which began at a monument at the bay shore and ran southwesterly to the extreme westerly end of the track, striking monuments at Stevens and Pine Aves. and Feltus St., and the *north* edge of a black oak tree on the westerly side of Broadway.

Since then the black oak tree has disappeared, and a monument has been set near the westerly line of Broadway, but none knows under whose authority. As a matter of fact, this line is not straight; and throughout its entire length runs on what was formerly the company's property.

i. Broadway was almost the first street built along which the town began to grow in the early "fifties," the higher ground on either side of Henry St. being first used. Since then Henry St. has been filled up about 10 ft.

k. Almost every lot fronting on Broadway contains a surplus, all cross streets a deficiency, and the entire tract contained a large but unknown surplus.

In November, 1887, I was employed by the defendant in an action in tort, which hinged on the location of one of the subdivision lines of one of the blocks fronting on Broadway.

I first collected nearly all of the data already given from testimony taken in previous suits over property lines in the same place, from conversation with property owners, and from searches in the county clerk's office. Some few unimportant points were not brought out until a later stage of the work.

I then stated to my client that it was my intention to start at the original location of the company's line and measure the distance to Conover's line, determine the amount of the surplus, and distribute it uniformly throughout the length of Broadway. If his building was located within the line so established, I was ready to go on with the case, otherwise not, as I considered that to be the only proper way to make the location.

This method was followed out, the length along Broadway found to be about 16 ft. too long, which gave a correction of +0.55 ft. per 100 ft.

It was found that the building was safely located, allowing the excess, although the contention was for over 4 ft. encroachment.

I then examined all properties fronting on Broadway, or near it, for corroborative evidence. For this purpose all lots fronting on Broadway were measured, the center lines of all blocks were examined and generally located, and all old buildings near Broadway were located.

The distance of each lot line was then taken from the map, the proper correction added, and the result compared with the measured distance.

A remarkable agreement was observed with the existing location, with the latest Perrine location, and with the stone set by D——; later, when engaged on the resurvey of the borough, even better results were observed on streets 2,000 ft. west of Broadway.

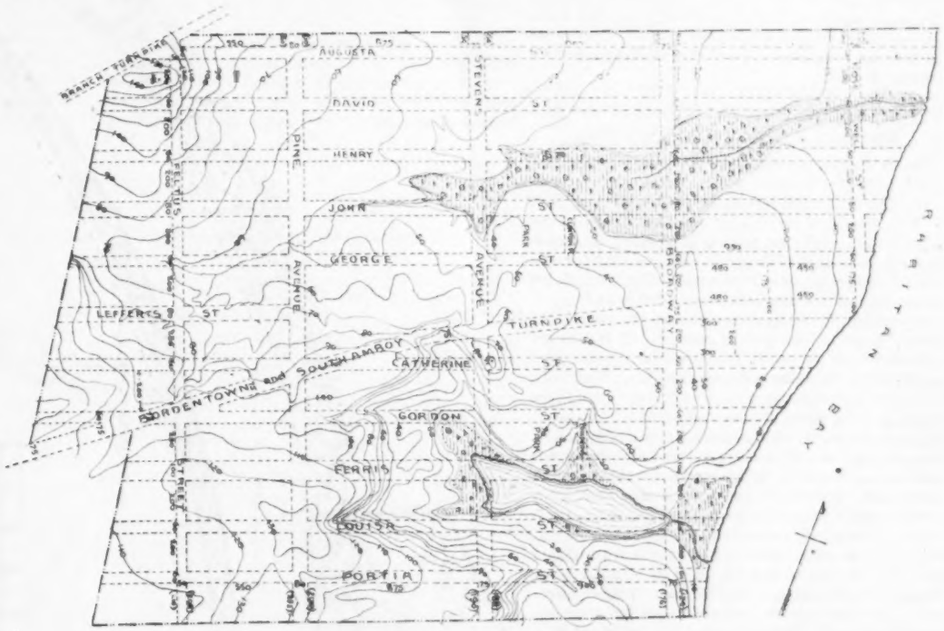
This agreement I take to be the best proof of the correctness of the assumption that the chain used in laying out the track and in the earlier lot locations made by J. P—— was too long.

The cause of this error and the general fact that link chains are never trustworthy are too well known to require comment, except of a nature unfavorable to the intelligence of the man who still uses one.

As a result, after a thorough trial of the case, we received a verdict, the jury staying out not to exceed ten minutes.*

This trial thoroughly aroused the people, for it was clearly shown that nearly every property owner was at the mercy of his neighbor, since a color of right could be had for a contest beginning with the first lot in the tract and extending throughout its entire length and breadth; as a consequence, the township of South Amboy, by a popular vote, took advantage of the State laws and was incorporated as a borough of the first-class early in 1888.

An ordinance was then passed to determine and locate the lines of the streets of the borough, and I was employed to do the work.



The Resurvey of South Amboy, N. J.

In another part of the borough a tract laid out in 1806, with all of the subdivisions staked and almost immediately occupied and fenced, the correction was found to be practically the same, and an apparent angle of 90° had a value of 89° 37'.

We could go on multiplying instances, but the method we have adopted, based on the above and similar experiences will, we think, when stated, better serve the purpose for which this article was written.

1. Having made copies of all available maps which touch or cover the tract, connect all existing monuments, and if at any corner there has been a fill dig down to the original surface over an area of several square feet. If you don't, and somebody else should find a monument, you might feel badly.

This will give you the correct length of the chain used in laying out the tract and the correct value for an apparent angle of 90°.

2. If there are no monuments in existence, survey the entire tract and its subdivisions, locate everything, talk to every person who knows or thinks he knows anything about it and volunteers information. You will get in this way from 75 to 90 per cent. chaff. Then hunt up the large property owners and get them to talk. They generally don't volunteer, but know something.

3. Get copies of the original deeds of your tract and the adjoining ones. They often give valuable assistance.

4. Write down a statement of all that you have learned without attempt at classification. Weigh each piece of evidence and build up a rational theory from it, examining your map constantly to see that it all fits.

5. When you make your location, do not disturb

* It is neither desirable nor practical to give a summary of the testimony adduced during the trial, other than that already given but I desire to state that much valuable assistance and testimony was given by C. C. HAVEN, City Surveyor of Trenton, N. J., who agrees with me in the results obtained, although not entirely in the process by which they were reached.—G. H.

lines that have been 25 or 30 years in existence unless they do your client or some one else a manifest injustice, and even then proceed carefully.

Herein lies really the great difficulty, and nothing can overcome it except experience and judgment.

6. If the tract is unimproved and monumented lay out your lot using the excess method, unless some State law or city ordinance disposes of the surplus for you.

7. If the tract is not improved and not monumented, and you are not employed by the original owner, keep off.

8. If you want to do satisfactory work under all conditions use a ribbon chain (Young's) with a spring balance, sag it and plumb down from the ends. The additional time, when once used to it, amounts to nothing, and the satisfaction of doing good work to a great deal.

The Roof of the Main Drill-Room of the 22d Regiment Armory, New York City.

While a complete description of the new armory, now under construction at 68th St. and Ninth Avenue, New York City, for the use of the 22 Regt. N. Y. S. N. G., would be interesting reading, the roof of the main drill-room is the feature of greatest engineering interest, and through the courtesy of the designing engineer, Mr. F. STUART WILLIAMSON, we illustrate and describe this roof as follows:

The main drill-room covers an area of 40,000 sq. ft., a little less than one acre of ground. It is covered by a steel roof of 176 ft. span and 62 ft. clear rise, as shown in the accompanying sketches. The main ribs or arches are 24 ft. 6 ins. apart and spring from masonry at a point 18 ins. below the floor level. These ribs are 5 ft. wide at the base, increase to 5 ft. 6 ins. at one-third of the upward rise, and then gradually taper to 4 ft. in width at the center or crown of the arch. Two radii are used for this arch, both in the inside and outside curves.

The plans given show the general construction, but it may be added that the members throughout are made of angles and plates riveted with ¾-in. rivets. The feet of the main ribs rest upon carefully planed bed-plates, and are connected together by two steel rods passing across the building in a tunnel running under the floor. These rods have sleeve-nuts at suitable lengths. The bottom panel in each rib is ornamented on each side by an iron casting bearing a shield with the motto of the regiment. At eight points in the main ribs latticed purlins run longitudinally and brace them together, though their more particular use is to carry the intermediate rafters, which are latticed and of similar construction to the main ribs, and of course follow the outer curve of the latter.

One end of alternate purlins has slotted holes in the connecting plates to allow for expansion and contraction in the length of the roof. Every alternate panel formed by a main rib and its purlin is braced diagonally, against wind action or other vibration, by round rods with adjusting thread and nuts at each end. A sky light 25 ft. wide runs the entire length of the roof, and with its movable sashes affords ample ventilation.

On each side, as well as at each end of the drill-room, galleries are arranged. Those at the sides are suspended from the main ribs by means of brackets secured to the chords. For the erection of this roof a traveling stage has been devised running on rollers, and equal in width to one bay of the roof. Platforms are placed at the several points and levels where the ribs are jointed, making the arrangement of all connections easy and convenient. All hoisting and riveting is also done by means of this stage. As the work of erection progresses, the stage is moved on until the entire structure is in position.

A late test of the 5 in. × 3 in. angles used in this roof shows excellent results. The angles were rolled by the Catasauqua Manufacturing Co., of Pennsylvania, and the tests were as follows:

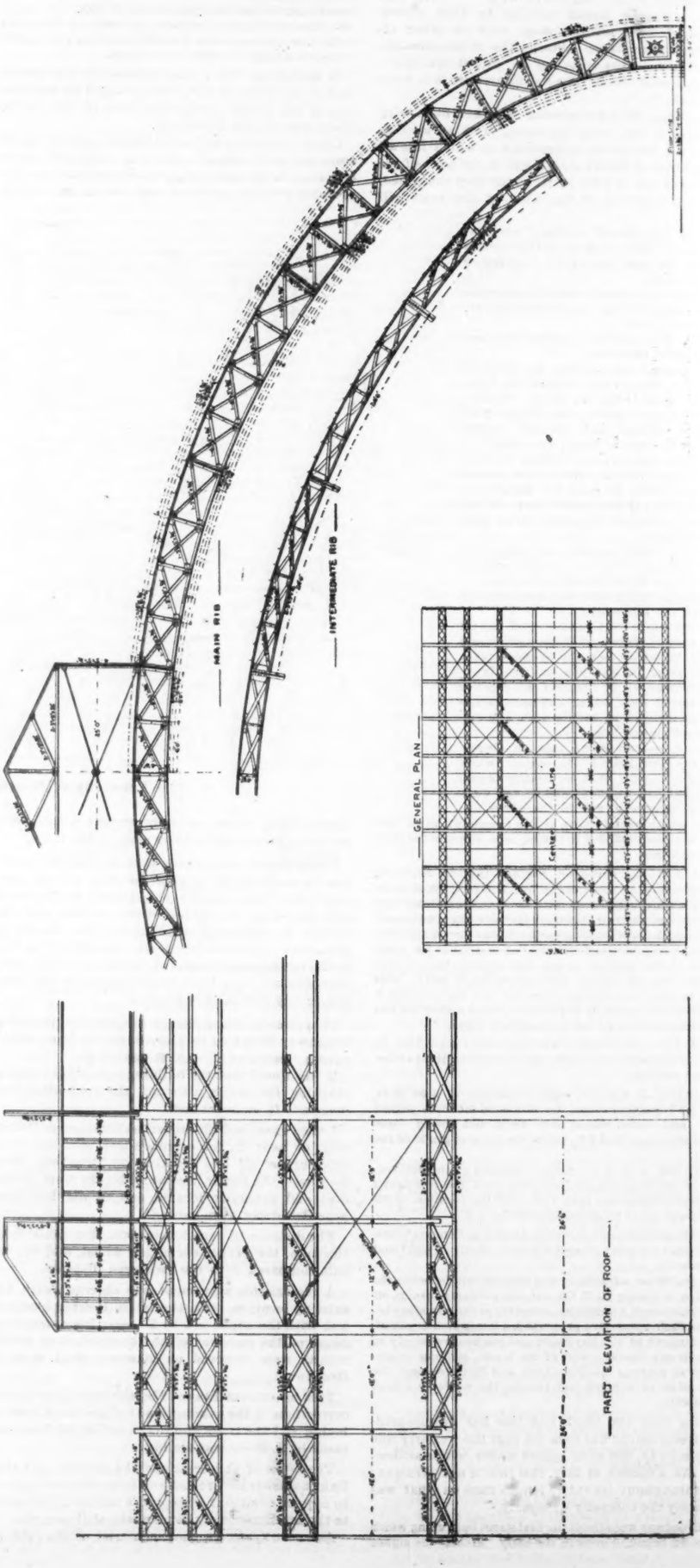
Test Piece cut from the 5-in. leg of 5 × 3 in. by 12.8 lb. Steel Angle.

Ultimate strength	58,160 lbs.	per. sq. in.
Elastic limit	30,455 "	" "
Per cent. of reduction	50.5	

Test Piece cut from 3-in. leg of 5 × 3 in. by 12.8 lb. Steel Angle.

Ultimate strength	58,020 lbs.	per. sq. in.
Elastic limit	30,455 "	" "
Per cent. of reduction	54.05	

The contract price for the entire armory is $300,000, and the weight of the drill-room roof alone is



Roof of Main Drill-Room of 22nd. Regt. Armory. New York City.

over 300 tons. The metal-work described is being constructed by the Wallis Iron Works, of Jersey City, N. J., from designs and working drawings made by their engineer, Mr. F. STUART WILLIAMSON, M. Am. Soc. C. E.

Gaugings of Sewer Discharge Contemporaneous with Rainfall.

BY EMIL KUICHLING, MEM. AM. SOC. C. E.

In the preceding paper, an attempt has been made to exhibit briefly the different methods by which engineers of the widest repute and experience have been accustomed to estimate the greatest amount of rainfall, or storm water, for which provision should be made in the sewers of populous districts, and a modification of these processes was advocated by the writer, inasmuch as the data underlying such methods appear to be entirely inadequate to warrant unqualified acceptance. A careful analysis of all available records of the actual discharge of sewers in times of heavy or protracted rain, undertaken some years ago, revealed enormous incongruities or anomalies, which could only be explained by erroneous premises, and which accordingly left the whole subject in a very unsettled condition from a scientific standpoint; hence, when the writer was selected in October, 1887, to prepare the preliminary plans for the proposed East Side Trunk Sewer, he stipulated that a series of new and carefully conducted experiments should be made by him, with the view of ascertaining, if possible, a more trustworthy relation between the rainfall and the corresponding maximum discharge of a number of the principal outlet sewers in the territory under consideration. The expense involved by this undertaking was foreseen to be considerable, but it was regarded under the circumstances as thoroughly justifiable, since the knowledge thereby gained would be of enormous value to the community at large, in preventing the design and execution of insufficient drainage works at great initial cost, not only on the East side, but also in all other portions of the city.

It may be remarked in the outset, that while many of the difficulties subsequently encountered, were duly anticipated, yet the writer did not appreciate fully the extreme delicacy with which the sewer discharge always responds to variations in the intensity of the rainfall until a large number of observations had been collected, and the tedious computation completed; neither had he any reason to believe, from existing records, that rainfalls of uniform intensity for considerable periods of time were so comparatively rare. As a consequence, it was learned too late that the most delicate and accurate self-registering rain-gauges were essential to the complete success of the experiments, and that a comparatively large number of such devices should be distributed over the urban drainage area, in order to detect all local variations in the rate of precipitation. The results obtained from the gauges used in the work are therefore susceptible of much criticism, yet it must be remembered that not only were no precedents for the undertaking available, but that the appliances and methods of observation adopted were, on the whole, much more trustworthy than in the case of similar experiments elsewhere.

The general plan of the work was as follows: 1. The rainfall was observed at four different stations within the city limits, located from ¾ to 1½ miles apart. Two of these stations were equipped by the writer with carefully designed gauges presenting an opening of 9 ins. in diameter, and with delicately adjusted balances for weighing the water caught; the third station was provided with a similar apparatus and is maintained by the City Water-Works Department; while the fourth was the station maintained by the United States Signal Service, the depth of the rainfall here being measured directly in the gauge itself by means of a graduated scale. The observers were all urged to take the utmost care in noting the exact duration of each heavy rain, and also to record the duration and weight or depth of the water caught when the intensity of the rain appeared to vary, thus dividing an irregular storm into its component parts or showers. Independent records of relative intensity and duration of such rains were also kept by the writer and his immediate assistants, who, by constant practice and comparison with the measured results, were soon enabled to form a tolerably accurate estimate of the rate of precipitation from both the sound of the rain upon the roof of the building, and the appearance of the street gutters. The two gauges maintained by the writer were placed about 35 ft. above the surface of the ground at the Municipal Gas Works and the Rochester Bridge Works, where they were entirely free from the influence of surrounding buildings, while the Signal Service gauge was located over 100 ft. above the surface on the top of the tower of a lofty building in the center of the city, and the Water-Works gauge was stationed on the bank of Mt. Hope reservoir, which is on the crest of the range of hills in the southern districts. A comparison of the records of these four gauges afforded the means of determining whether the rainfall was evenly distributed over the whole territory. 2. The maximum flood-flow in the principal outlet sewers of the East Side was obtained by means of self-recording gauges, located both in the manhole and in the open channels or ditches which receive the discharge of such sewers in the suburbs. Owing to the nature of the liquid, delicate mechanical appliances could not be used for securing such measurements, as the solid matters in suspension would quickly obstruct the satisfactory operation of such instruments; and after much experimenting, the following simple device was found to give the best results. A thin strip of wood, 4 ins. wide and ¾ in. thick, was painted white and coated with a thin wash of whitening or pulverized chalk and immediately sprinkled over with carefully sifted coarse sand; thus prepared, it was then inserted and fixed in a suitably grooved and narrow frame, which was securely fastened to the sidewalks of the manhole, or in an enclosed and locked frame-work, secured to a post driven into the bottom of the ditch. The strip rested at its lower end upon an iron support firmly secured to the frame, and its rise by floatation was prevented by putting it snugly under the curbing or covering of the manhole, and by a locking device in the case of the open channels. Being exposed on both sides to the water or sewage, the thin wash of whitening was quickly softened by contact with the liquid, and the sand immediately dropped away from all places which had become immersed, but remained fixed on the surface of the strip above the flow-line. A sharply defined maximum flood-mark was thus obtained in almost every instance, and from the height of this mark, as well as from the previously ascertained relation of the iron support to the bottom of the sewer or channel, the greatest depth of the stream was definitely known. The cross-sectional dimensions and slopes of the sewers and channels so gauged were also carefully measured, so that all of the elements required for the computation of the maximum discharge were available. These gauges were examined immediately after every heavy rainfall or shower, and the surfaces of the strips newly prepared as above described.

It had been noticed previously by the writer that the discharge of certain large sewers in this city varied with the intensity of the rainfall, as well as its duration, and numerous subsequent observations during the past year abundantly corroborated the view that comparatively slight variations in the rate of precipitation are quickly felt in the sewers, thus establishing the fact that the flood-marks must be attributed to the maximum intensities of the rain during relatively short periods of time, and not to the average intensity for the entire duration of the storm unless it be proven that the same was uniform throughout. The greatest care is therefore necessary in the observation of the rainfall and its variations, otherwise the deduction from the sewer-gaugings become highly deceptive. It may also be mentioned that the period of maximum discharge is usually equal to the duration of the corresponding maximum intensity of the rain, and that the flow is not in the form of a short, sharp-crested wave of momentary duration like that produced from a flushing tank. Thus, in a heavy shower lasting 20 minutes at uniform intensity, the maximum shower discharge will continue for about the same length of time; and as this period is amply sufficient to flood any cellar or basement when a sewer is overcharged, the damage is then as great as if the duration had been longer. The importance of dealing with shorter periods of time than heretofore customary will accordingly be apparent.

(TO BE CONTINUED.)

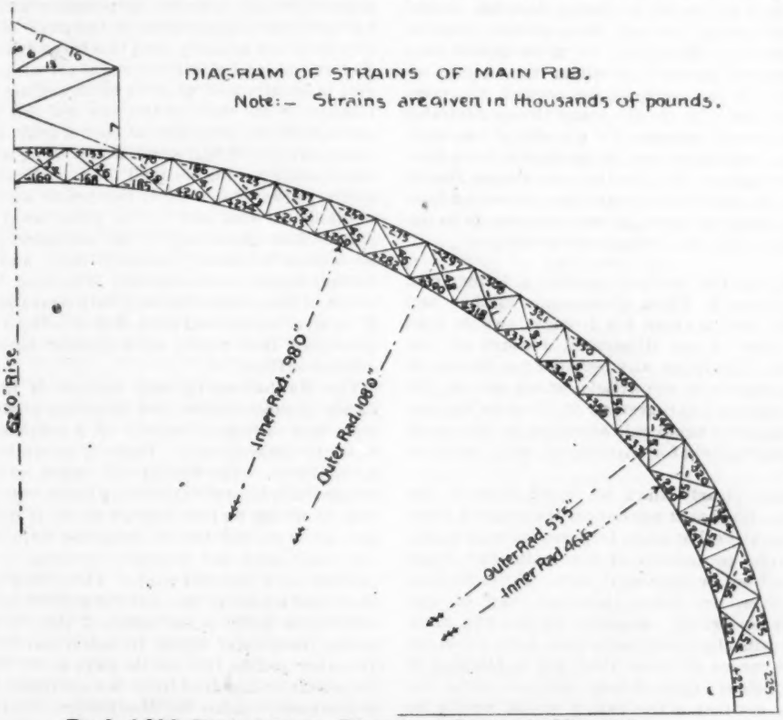


DIAGRAM OF STRAINS OF MAIN RIB.
Note:— Strains are given in thousands of pounds.
62'0" Rise
Inner Rad. 98'0"
Outer Rad. 108'0"
Outer Rad. 535"
Inner Rad. 466"

Roof of 22d. Regt. Armory; Diagram of Strains in Main Rib.

A CORRESPONDENT from St. Cloud writes us:

"We witnessed a freak of the elements here yesterday which may be of interest to you. After rain and snow, the ground thoroughly wet, we had a shower of black mud which bespattered everything exposed."

The same phenomenon was noted in the press despatches, but with even less detail than in the above note. We merely tell the tale as it was told to us, and do not attempt to explain the phenomenon.

ENGINEERING NEWS
AMERICAN RAILWAY JOURNAL

Published Weekly at Tribune Building, New York.

VOL. XXI. Saturday, April 13, 1889.

D. McN. STAUFFER, A. M. WELLINGTON. EDITORS.

GEO. H. FROST. - - - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year; $2.50 for Six Months; $1.50 for Three Months; Single Copies,* 12 *cents.* FOREIGN COUNTRIES, $6.56 *per Year, or* 3 *cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also,* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, April 16. Secy., S. M. Wickersham, Penn Bldg.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, April 17. Secy., S. E. Tinkham, City Hall.

American Society of Civil Engineers, New York.—Regular meeting, April 17. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Regular meeting, April 17. "Sanitary Condition of the Water Supply of New York City," Prof. C. C. Brown; "Easement Curves, Missouri Pacific Ry.," Willard Beahan. Secy., Wm. H. Bryan, 709 Market St.

New York Railway Club.—Next meeting, April 18. Rooms 113 Liberty St., New York City.

Engineers' Club, Philadelphia, Pa.—Regular meeting April 20. Secy., Howard Murphy, 1122 Girard St.

Western Society of Engineers, Chicago, Ill.—Regular meeting, May 1. Secy., John W. Weston, Gaff Building.

Association of Civil Engineers', Dallas, Tex.—Regular meeting, May 3. Secy., E. K. Smoot, 15 No. Jefferson St.

Engineers' Club of Kansas City, Mo.—Regular meeting, May 6. "Foundations for the Lillafjord Bridge," Otto F. Sonne. Secy., Kenneth Allen, 310 Baird Building.

New England Railway Club, Boston, Mass.—Regular meeting, May 8. "The Compound Locomotive." Boston & Albany passenger station.

Civil Engineers' Club of Cleveland, O.—Regular meeting May 14. Report on Applied Science. Secy., James Ritchie, Case Library Rooms.

American Society of Mechanical Engineers.—The annual meeting will be held at Erie, Pa., May 14, 15 and 16. Secy. F. R. Hutton, 206 Broadway, New York City.

A CORRESPONDENT writes us objecting to our answer to C. E. C. in our issue of March 30, in which we "rightly permit him to run heavy engines around a 250-ft. radius curve, under special circumstances, but limit him to two or three trains a day. There may be some profound underlying truth in this restriction, but it occurs to the careless reader, if one train can get around, why not a hundred, provided they are not trying to go around in opposite directions at the same time. Your correspondent dropped in here for the information, being authorized by the Chamber of Commerce to spend $5 to obtain it. Finding he was in a high-priced office, a brilliant thought struck him: he might save $4.98 by applying to your storehouse of wisdom; and he obtained the information wanted."

Had we known that we were competing with even a $5 professional fee in the manner narrated in the last sentence above, we should have been disposed to decline to do so. It is one of the difficult points in conducting an engineering journal to decide where the legitimate field of general inquiry ends, and the field of specific advice as to particular problems begins, on which it is not the proper province of a technical journal to enter. We make it a rule carefully to respect this line, as our readers will bear witness. It is not very long since an inquirer as to "how to proceed to design a warehouse floor," was advised to proceed to the nearest competent engineer's office.

Still, it appears to us that the query here referred to was one of that general nature which might properly be answered as it was; and referring to that answer, the "profound underlying truth" which dictated a limitation of the service over the curve to "two or three trains a day," was simply that such was the service specified in the inquiry. It is an established principle of jurisprudence, which every giver of advice, gratis or paid for, will do well to live up to, that a decision should never extend beyond the specific question submitted. Moreover, he must indeed be a "careless reader" to whom the query occurs, "If one train can get around, why not a hundred?" There are many things advisable and almost harmless for a traffic of one train a day, which are not all advisable for a hundred trains a day, for the very simple reason that the disadvantage and loss becomes a hundred times as great in the one case as in the other, while the saving is no greater.

WE print in another column a letter from Mr. CHAS. B. PRICE, giving some further and fuller details about his frogless switch than we gave in our illustrated account of last week. The letter was received too late to incorporate with the article, which we are the less disposed to regret, as it gives us the opportunity to again call attention to this most promising field for experiment and improvement.

More clearly than we could show it the letter shows that neither on the score of price nor on any other score is there real reason why a large proportion of the main line frogs should not be done away with. From the data it gives, we judge that the cost of the frogless switch complete, leaving the main line rails absolutely unbroken, need not at the most exceed by more than $45 to $50 that of the ordinary type of frog switches, while the wear and tear of the switch would hardly be one-tenth as great on an average, and often not one-fiftieth, since it would depend only on the number of trains taking side-track, instead of, as now, on the number of main-track + side-track trains. There would, therefore, in the end, be a very decided economy, even allowing that the maintenance cost of such a frog per thousand trains *actually passing over it* would be somewhat higher than with a common frog, as it doubtless might be. But to put the question on a purely financial basis is unfair. Every frog, besides being expensive, is a source of danger, from possible obstruction, possible breakage, and possible breakage of a wheel, especially when it is run over at a high rate of speed, as so many are; and all the saving in wear and tear of rolling stock, moreover, is in addition to that above noted.

We therefore recommend and urge upon engineers and other officers of maintenance of way who may be in a position to do so, that they experiment in this direction. It is not often that we venture to say as much, since we have no wish to be instrumental in leading anyone into hopeless experiments; but we are satisfied that any fairly made and adequate test will prove anything but hopeless.

THE proposed loop in the Manhattan Railway, at Battery Park, is being energetically pushed in the press of this city by the Manhattan management, and it must be said that the arguments in favor of a loop terminal are generally sound, and that such an arrangement would doubtless add materially to the traffic capacity of the roads by reducing the interval between trains, even though the Trustees of the Brooklyn Bridge do not seem to agree with the Manhattan management in this loop terminal feature. The real Battery Park would be less encroached upon by such a loop than many people suppose who have not examined into the matter, and as a park, this "most beautiful spot with a water front on the globe," has a very limited field of usefulness to the people of New York when compared with the general advantages of better rapid transit facilities. But what we do most decidedly object to is, that the right to build this loop and occupy more ground should be granted to any private corporation without full and due compensation to the city. If the city does not actually need this bit of park for its own use, and no other piece of private property is equally well adapted to the engineering features of the case, let the city sell this land outright to the company, at such a price as an equal amount of real estate would bring in the same locality. Public land, and particularly public parks, are entirely too scarce and too valuable in this city to be given away, no matter how great may be the estimated public benefit from any proposed use. And we further doubt the expediency of parting with a foot of the present Battery Park at any price, if on no other ground than that of being a bad precedent that might work greater harm in other localities.

The Manhattan railway system is in the hands of shrewd, able, and far-seeing business men, who operate it purely on a commercial basis, to make money. There is no sentiment about them. The rise in real estate, and the wonderfully increased traveling facilities in this city, of which we now hear so much, is doubtless all true, but this is rather an unlooked-for result than any primary intention of the promoters of elevated roads. The advantages to the public are great; but the greater the facilities for traffic in the hands of this corporation, the greater also is its individual profit. In other words, the public pays a fair price for all favors received from the company, and to increase its gains the Manhattan Company should be ready to pay in return for privileges granted it by the city; or, better still, to purchase real estate, like any other private corporation, when its plans for extension require it.

THE Main Street arch question, in Springfield, Mass., is still under discussion, and the *Republican* of that city makes the sensible suggestion that a metal arch would after all be the lightest and most eye-pleasing structure under all the conditions of use and position. While we would advocate stone under all proper and reasonable conditions, the multitude of designs presented proves the fact that the present problem is a very complicated one, with its screens and exceedingly light rise. A metal arch could be undoubtedly designed that would answer all the requirements of the case and furnish a light and graceful structure; but, if metal is the material adopted, and the question of light and room in the opening under the bridge is to be considered—as it should be—then a plate girder, with the roadway on the lower chord, would appear to be the best solution. Such a girder can be made decorative and can be combined with very handsome masonry; and it would undoubtedly furnish the maximum of space for the street below, and least obstruct the view down the street; and a

plate girder of the requisite depth, with the tracks between the girders, would conceal a sufficient surface of passing trains to practically make any further screens unnecessary. A bridge of this character would have the one great merit of making this screen in a great measure a necessary and component part of the bridge construction, and not a mere addendum, serving a more or less useful purpose, but forming no part of the design proper. Curved brackets of good design over the footways would give a certain arch effect, and properly relieve the junction of horizontal and vertical lines. Even if the extreme specified height of screen is insisted upon, it should be a less difficult problem to handle, from an artistic point of view, than if the bridge were built of stone. It would seem that from the standpoints of fitness of purpose, position, prospective use, and general economy, the metal design was well worthy of consideration.

JUDGING from the position taken by the daily press of Chicago, the present fight over the selection of a mayor for that city is very largely a question of civil engineering. The Chicago *Inter-Ocean*, which favored the re-election of Mayor ROCHE, sets forth as his chief qualification his advocacy of the purification of Chicago water, the disposal of Chicago sewage, wider bridges, more viaducts, etc. And the same journal points to alleged engineering mistakes made in office by another prominent candidate as the chief objection to his election. It is evident that civil engineering is an important and recognized element in Chicago politics. From the statements made it would appear that, if Mayor ROCHE is not an engineer himself, he has realized the importance of having good professional advice in such matters, and, further, that he had the good sense, if all that his friends say of him is true, to pay more than the average heed to such advice.

AND, it might be added that, whatever may be the real incentive in the *Inter-Ocean* for the position taken, the implication that engineering skill and knowledge are important qualifications in the municipal head of a live American city, is nearer the truth than even that journal may realize. The professional training and experience of a civil engineer would really be of greater profit to such an official than that of any other one profession. In this day of important municipal projects, rapid transit, electric subways, drainage, sewage disposal, etc., public works, more than anything else, should occupy his time and call for his most careful consideration and intelligent judgment. By the aid of competent technical advice he may be able to perform this work fairly well; but no one will deny that he could do it much better if the knowledge and experience were all his own. Under the present form of government, in the great majority of our larger cities, the mayor is the executive head whose decision is necessary and vital in all matters pertaining to public improvements, and an engineer of ability and experience would be much more likely to prove an efficient leader and valuable official than one who had to found his decisions on the judgment of someone else. Hence it is that we would say, with the *Inter-Ocean*, that the better engineer is likely to make the better mayor, all else being equal.

Two instances which have come to our knowledge during the past week lead us to again call the attention of our readers to the fact that justice to both sides requires that the notices of engineers seeking engagements, which appear in our "Want" columns should be examined by everyone having vacancies to fill for which entirely acceptable candidates are not at hand; and, moreover, that public notice of the existence of such vacancies should be made through the same medium before finally filling them; to the end that the best man may win, and every man have a fair chance. In one of these instances, an engagement was secured through such a notice; in another, a conspicuously fit man was secured for a position requiring somewhat unusual qualifications. It must be perfectly obvious to every thinking man that there is especial need in the profession of engineering for some such recognized medium of exchange between candidates seeking desirable positions and positions seeking desirable candidates, without which the interests of both sides must frequently suffer. Doctors, lawyers, architects, and clergyman plant themselves in one place, and rely (all except the last named) on a multitude of small engagements, all originating in their near vicinity, rather than a series of single long engagements scattered all over the continent, and we may almost say, over the earth. As a consequence, there are constant instances of great hardship, both from qualified men missing engagements which they did not know of till too late, and from important positions being unworthily filled simply because no better men were known to be available. Of course, in many cases—we may even say in most cases—there are men at hand for vacancies whose qualifications are known and who are justly entitled to preference, *other things being equal*. But "other things" are very unequal when there is a far better man in far greater need of an engagement a few hundred miles away, who lacks only means of knowing of the vacancy, or of making himself known; and as the only harm which can result from a previous precautionary public notice is that a small pile of letters may have to be looked over and thrown away (nor even that when the notices of engagements desired which appear in these columns are looked over before filling vacancies) we feel justified in urging upon all with positions to fill that they both read these notices and give like notice themselves of vacancies, before filling them.

AN incident well illustrating the hopelessness of various attempts which have been made from time to time to dispense with a fireman on locomotives, by the use of liquid fuel or electricity, especially on short local runs, occurred on the New York Central road last week. The St. Louis express train left Buffalo with Engineer LEWIS at the throttle. A few miles west of Rochester, the fireman was startled to see LEWIS fall from his seat to the floor of the cab. The fireman stopped the locomotive, and the unconscious engineer was examined by physicians on the train, who found that he had died almost instantly of heart disease. He is stated to have been over seventy years old, which, in our judgment, is far too old for any man to run a locomotive, especially on a fast passenger train; but similar sudden deaths or faints happen from time to time among men of all ages, and are particularly likely to happen in some sudden emergency. A cruel sort of a hoax was perpetrated some years ago of a fearful slaughter on a Fulton ferry boat, due to sudden death of a pilot just as it was entering the slip. The extremely reasonable nature of the hoax contributed to great local excitement, but it did not suffice to cause a reversion of the then dangerous practice of trusting the safety of crowded boats entirely to a single man shut up alone in a pilot-box. Two or three years later, however, an incident exactly similar to that imagined in the hoax occurred, with the lucky exception that the pilot fell dead just as the boat was to leave the slip instead of just as it was to enter it. Since then, no pilots have ever been allowed alone in the box during the passage. On a railway train the necessity is in one sense less, but in another even greater. Should electric propulsion ever come in, however, the fireman will become so purely ornamental an adjunct, as respects regular duties, that there will be a great temptation to dispense with him.

WE have received several further communications in respect to keeping level notes. One Canadian correspondent, educated under the English system, expresses a great preference for the modified form of the American system shown in the compact columns at the side of this note, the rest of the page being devoted to "Remarks." There is something to be said for this form of keeping notes, as there is for all forms. Compactness is a merit, other things being equal, and any one who likes such compactness as that shown will probably find this form of notes just the sort of thing he wants. But we have published a good many communications on this subject, including several after a first resolve to publish no more, and must now decline to give any further space to the matter. It is rather an important question, in view of the immense volume of these notes taken; but after all, the quality of the work is the main consideration, and that depends far more on the man than on the form of the note-book.

Stations or Distances	Readings	Elevations
		102.33
	4.77	107.10
	3.39	103.71
200'	4.51	102.59
435'	4.12	102.98
	5.60	108.58
700'	4.93	103.65
900'	4.40	104.18
1000'	4.15	104.43
	5.66	110.09
1200'	5.11	104.98
	5.04	105.05
1400'	4.35	105.74

Are Steel Rails Harder on the Outside?

A novel and curious question, in regard to which we dare say there may be considerable difference of opinion among engineers if they express their impressions off-hand without stopping to investigate, was raised in the contention which we note elsewhere between two street rail manufacturers,—Which is the hardest part of an ordinary steel rail, the inside or the outside, and if there be any difference how great is it, and how far in does it extend?

It is a marked instance of the abuses to which our patent laws are subject that such a question should arise from a patent for an alleged new invention of bending rails cold. Rails have been bent cold, and in no other way, from the year 1 of the railway era to the present time; and even if it were a fact that there was a certain hard outer surface which was lost by heating, a patent which claimed as new, for one kind of rails (steel street rails) an old and universal mode for bending all rails (*i. e.*, bending cold) on the ground that if they were bent in some other and new way the outer surface would suffer an injury which had not heretofore been noted, is a plain abuse of the patent law, and one which probably would have had no standing before the courts had it been admissible to challenge the validity of the patent in the case which led to the tests recorded in this issue.

Unfortunately, however, or fortunately, as one chooses to regard it, there are legal obsta-

cles which forbid a licensee from attacking the validity of a patent as a defense against payment of license. It is not apparent to the non-legal mind why this should be so. It seems as if no one ought to be obliged to continue paying something for nothing because of a contract based on the assumption that the seller had something to sell. It would seem as if the buyer ought to have the right at any time, when he became satisfied that a patent was invalid, to refuse to pay license longer on that ground alone, subject to the obligation to establish its correctness in the courts. But such, it appears, is not the case, and no doubt there is better reason for it than appears to the lay mind; while to it we owe the interesting investigation chronicled elsewhere, which we desire to supplement by briefly summarizing its results and seeking further evidence from our readers, if they have any on either side.

The claim of the patent was, not simply that a hard but loose *scale* existed on the outside of rolled steel, composed largely of oxide of iron, and almost as gritty as emery, which is well known to be the case, but that there was, apart from and inside of the scale, an actual "skin" of harder metal than that of the interior, which might be from $\frac{1}{32}$ to $\frac{1}{16}$ in. thick, and which was so much harder than the rest of the metal in the rail as to materially prolong its average life; and that this skin was lost, not only if cut off, but likewise if the rail was reheated to a red heat in order to bend it.

This theory has at least sufficient standing among practical men to induce the chief inspector of such material for the Pennsylvania Railroad to testify very emphatically to the existence of such a skin, beside the patentee and other interested parties, who were themselves men of long practical experience. It was alleged among other things that steel rail frogs which had had the skin planed off them in places, where the metal was exposed to wear, had very rapidly worn away, whereas the same kind of frogs with the skin left on had shown much greater resistance to wear; and that the street guard-rails bent hot showed a notable difference from the same rails bent cold; but as to this latter fact no definite records were given.

The chief definite evidence on the other side was the series of actual tests reported elsewhere by Messrs. Hunt & Clapp of the Pittsburg Testing Laboratory, than whom there are none more competent to make such tests properly. These tests tended to show that the exterior was if anything softer than the interior, that it had less density, and had lost by burning or segregation in the molten state considerable of the carbon, manganese and other hardeners, which were always found in greater proportion in the center of the mass. Direct abrasion tests, of a type which we have heretofore suggested as the best possible for determining the actual hardness of rails,* and which are unquestionably as promising a method of determining this fact by any form of quick tests as can be devised, confirmed these apparent conclusions. Tests by grinding upon an emery wheel gave such irregular results as to be worthless as evidence, but certainly lend scant support to any such theory, even if we accept the aggregate without respect to the lawless units of which it is made up, which it is needless to say it is not admissible to do.

In weighing this evidence pro and con, it is difficult to be very dogmatic about it on either side, since the question has not heretofore been made the subject of experiment, so far as we know; but it is a point which for several reasons it is desirable to have definitely settled and recorded, and we shall be pleased to give space to any actual facts or observations tending to settle it which any of our readers may know of. We may say at once that we have no belief that any such contrast exists. The very fact that it has not been made the subject of experiment and record seems to us the most conclusive evidence on this point, although it is only negative evidence. If any such difference existed it would surely have been long since generally noted, and its conditions and extent experimentally recorded.

The next question which arises is: What is there to cause any such hard skin? One certain and well-known way for producing a hard outer shell on either iron or steel is by cold-rolling, but there is nothing even approaching cold-rolling in the ordinary process of rolling rails, and more is the pity. So far from that, in order to prevent the thinnest part of the sections from becoming too cool, and in order likewise, we fear, to enable the rolls to be run at higher speed than is possible unless the metal is very fluid. The thicker parts of the metal are almost white hot in some cases when they leave the rolls. It is to avoid this danger that the modern tendency has arisen to thicken the base and the web and lighten the heads, despite the plausible reasoning that, as the head is the "business end" of the rail, that is the part that ought to be made heavy. With the very thin web and bases and very heavy heads which have been in fashion, it was and is an absolute necessity to have the heads very hot when they leave the rolls, as the only alternative to having the thin parts so cold that they cannot be run through the rolls at all.

Now, with metal so hot as to be rollable is there any such difference in the effect on the inside and outside of the metal as results from cold-rolling? It appears to us not. There will be no question that the colder the metal is when it leaves the rolls the more solid and compact it is likely to be *as a whole* when it leaves the roll, but as between cold-rolling and hot-rolling there is this vital difference: The cold metal is a solid; metal red-hot or hotter is merely a viscid fluid. The interior may be a little hotter than the exterior, but not materially so, and as the whole mass is yielding, it is difficult to see why one part of the metal should be compressed more than another. Conceive a perfectly cold shell placed around the hot rail. It is obvious that there would be practically no cold-rolling effect produced on this shell, while the interior was hot. The whole work would be expended upon the viscid interior, and the amount of this work would be measured by that necessary to cause the most fluid metal to flow or compress. Hence, so long as there is viscid interior, it would seem natural that the greater portion (or at least an equal portion) of the work of rolling should be expended on that interior. When it becomes entirely cold, the conditions become quite different. It then serves as a solid anvil, between which and the rolls the skin is forcibly compressed; or rather hardened, for the actual compression is very slight.

Another method by which the skin might become harder is by some equivalent for a tempering process, but surely there is nothing like that in ordinary rail rolling; rather, the analogy is with annealing. The hot rails as they come from the rolls are simply laid together to cool slowly in the open air. While the cooling is too rapid to be called annealing, it does not appear to be such as would tend to cause a hard skin which would be lost by reheating, or which would be any great loss if removed by planing off the metal.

There is a very common notion that such a hard skin exists on rolled and forged iron as well as on steel rails, but as respects hot-rolled or forged metal, experiment affords it little countenance. Large bars do not test up to the unit strengths of small bars, as a rule, but this is for other reasons; and as respects the metal in a given bar, there is no support for the notion that we know of. Kirkaldy's 8th conclusion is: "The prevailing opinion of a rough bar being stronger than a turned one is erroneous." His 61st is: "The specific gravity is found generally to indicate pretty correctly the quality of the specimens"; and his 63d: "The density in some descriptions of iron is decreased by additional hot-rolling in the ordinary way; in others the density is very slightly increased." His 23d conclusion, indeed, is: "The 'skin,' or outer part of the iron, is somewhat harder than the inner part, as shown by the appearance of fracture in rough and turned bars;" but this conclusion is restricted to iron, and "harder" is not used in the sense of "stronger" or "tougher," but rather of "more brittle," as appears from the context. It does not by any means follow from anything stated by Kirkaldy that the exterior will resist abrasive wear better, and such difference as there is might well be due to the absorption of carbon by the exterior of the wrought-iron, while the exterior of steel appears from analyses to rather lose carbon.

If any kind of metal might be expected to show a harder exterior it would be a forged steel crank shaft, yet D. K. Clark, in his "Manual for Mechanical Engineers," gives an example (p. 595) of a great number of pieces cut from a large shaft, of which he says: "The strength of the specimens cut from the interior of the blocks averaged very little less than that of those from the exterior."

Similarly, steel driving tires might, from the process of manufacture, be expected to have more or less of a hard outer skin, since they are rolled much colder than rails, and their nearly rectangular section permits of more perfect compression. Yet experience with their wear (which has been carefully and extensively observed for the successive layers of metal, while that of rails has not) does not seem to warrant the conclusion that the outside is any harder than the inside. There is a tendency to report higher mileage before the first turning than before the second turning, perhaps; but the tendency is by no means universal, nor is it decided. Thus, in the Master Mechanics' Association report for 1888 (p. 110-11) there is an extensive table of such records, and taking the eight first and most complete, which are for 8 engines on two roads and cover four turnings of 3-in. tires, we have as an average:

	Wear in $\frac{1}{32}$ in.	Miles per $\frac{1}{32}$ in.
Before 1st turning.....	5.6	8,438
" 2d "	6.0	7,594
" 3d "	7.1	6,698
" removal.....	8.6	9,367

The average of the first and second is 8,016 miles per $\frac{1}{32}$-in., and of the third and fourth, 8,032 miles; certainly a close enough agreement, and the committee expressly point out that there is no evidence to indicate that quality of metal has anything to do with the relative inside and outside wear.

Some direct tests of hardness by the penetration of a pyramidal punch acted on by a given pressure, in much the same way as we have previously suggested, in our article above referred to, that a test for hardness of rails should be established, are reported in the 1887 M. M. Assocn. report (p. 139) which tend to show directly that the interior of the

*A Practical System of Rail Tests, Eng. News, July 21, 1888.

metal is the hardest. These tests were made at the Watertown Arsenal.

It is also a fact, according to our observation, that the flowage of metal under load on the head of the rail takes place, if anything, more rapidly while the rail is new; and also, that *good* rails which do not wear rough on top, lose metal by abrasion more slowly, if anything, after the head is worn down somewhat than at first (excepting always outside rails on curves, which soon wear to the shape of the flange, and then abrade much more rapidly). Such observations as these cannot in the nature of the case be definite, but merely based on general experience. If observations have been made to the contrary of this we do not know of them, and shall be glad to hear what they are. We shall also be still more glad to hear from anyone who knows of definite evidence either pro or con on this subject. It concerns every one interested in track to know what the facts are, and if there be in truth any hard skin to rails, or even the beginnings of one, how that incipient skin can be made still harder and thicker.

Electrical Accumulators.

LITIGATION on the subject of electrical accumulators or secondary batteries is attracting a marked degree of attention. The recent decision of Judge COXE, in the U. S. Circuit Court for the Southern District of New York, has been commented upon with more or less bias by both parties in the contest. The suit was entitled, the Electrical Accumulator Co. vs. Julien Electric Co. and WM. BRACKEN. As nearly as we can make out, the broad or foundation patent of M. FAURE was the principal patent in contest. This Faure patent describes the application of an "active material" to a plate or support; the "active material" being in the form of finely divided lead, lead oxide, a salt of lead, or any equivalent matter. Most commercial secondary batteries, as a matter of fact, are made by taking a thin sheet of lead, uniformly perforated, and applying a paste containing an oxide of lead, sulphuric acid, and water. The patent, however, states that this "active material" may be applied "in the form of a paint, paste, or cement, in the form of a deposit of galvanic action or chemical precipitation or otherwise."

Judge COXE finds that it was new, novel, and patentable at the time of FAURE's invention to apply the "active material" to a plate or support for use in a secondary battery in the form of a "paint, paste, or cement" and that the other methods of applying an active material, described in the patent, were either not clearly and fully described or were not of sufficient novelty to be claimed and controlled by FAURE. The Judge therefore decides that FAURE may file a disclaimer limiting his patent to a paint, paste, or cement, and may then have an injunction.

A disclaimer is a sworn statement to be filed in the Patent Office, and thereafter read as part of or explanatory of the patent; an injunction is an order of the Court that certain acts or operations described therein stop immediately; in this case, the "act or operation" would be the manufacture, use, or sale of secondary batteries made as described, if the injunction were granted.

We understand that the Accumulator company will file the disclaimer called for, and take an injunction. They are then at liberty to institute new suits against other infringers and upon filing their bill, ask for an injunction as a preliminary proceeding or action on the strength of Judge COXE's decision.

We are informed that during the two years of litigation between these parties, the charge of infringement was never denied, and it was proved by undisputed testimony that the defendants pasted their plates. The apparent difference in the statements emanating from the two contending sources arises perhaps from the fact that the defendants claim to have recently changed their mode of manufacture, and to be now applying the oxide of lead in some other form, presumably that of a dry powder, as this would appear to be the only form which can be considered without the claim of the patent as construed by Judge COXE. The Accumulator company state that they do not believe it possible to make a practically successful battery by that method; that if such a battery should be constructed, it would be a new and experimental form; it would virtually start the manufacturer in business with a battery occupying the same position commercially which was occupied by the pasted plate battery on its first introduction in 1880 or 1881.

The Julien company have frequently stated that they have placed upon the market 10,000 cells of their battery, and it is not strange that those parties who have invested their money in these cells should not be at all pleased at the possibility that they may be called upon either to give up their cells to be destroyed or to pay royalty to successful litigants. But the Julien company claim that there is not the slightest danger of any such result; that the decision was a substantial victory for them, and that no one need fear to suffer in pocket from using their batteries.

The Pennsylvania-Delaware Boundary.

There is a triangular bit of real estate between Delaware and Pennsylvania, says the N. Y. *Sun*, that has had almost as complicated a history for its size as Oklahoma or Greer county. The northern boundary of Delaware was declared in the original grant to be the arc of a circle with a center at Newcastle and a radius of twelve miles. Mason and Dixon's line fixed the boundary between Pennsylvania and Maryland. The blunders of the old surveyors made the Mason and Dixon line at its eastern end fail to reach quite to the arc of the Delaware circle. This left a triangular bit of land as wide at the top as the distance of this failure, and tapering down to a point where the arc of the circle extended, touched the eastern boundary of Maryland. Various measurements have made the area of this lost bit of land all the way from five hundred to fifteen hundred acres.

WILLIAM SMITH and his ancestors had lived there for generations, always supposing that they were in Delaware until 1849, when a survey by United States officers disclosed the old error, and made it clear that if WILLIAM SMITH lived anywhere it was in Pennsylvania. It chanced that at this time SMITH was a member of the Delaware Senate, and he was promptly dubbed in parliamentary proceedings "the gentleman from Pennsylvania." Stones were set up marking the new boundary, but the SMITH family refused to pay any attention to them, and kept on paying taxes and voting in Delaware as usual.

The son of the Senator, another William, managed to get some acts through the Legislature of the two States that he believed confirmed possession of the triangle to Delaware, and he settled down in the happy conviction that he had made his citizenship good. But in 1870 the census taker for the Pennsylvania township that adjoined him came around and insisted upon counting the SMITH family in with Pennsylvania, although the Delaware census man had already counted them once. There has been trouble over the boundary ever since, 'Squire SMITH refusing to acknowledge allegiance to Pennsylvania, and the Pennsylvania township attempting to force him to do so.

When the Baltimore & Ohio Railroad was being extended to Philadelphia the line ran across this disputed strip, and, uncertain whether an act of the Pennsylvania Legislature would not be necessary to obtain the right of condemning a right-of-way, the company hired 'Squire SMITH to buy for it outright the land needed. This called renewed attention to the little strip of land, and now arrangements are being made for a commission to take evidence and settle for good the question of the citizenship of the SMITH family and the jurisdiction over the "flat-iron" strip. Advantage has been taken of the uncertainty as to jurisdiction to make the strip the location in the past of several duels and a few prize fights, but with these exceptions nothing approaching bloodshed has marked the progress of the half-century struggle between WILLIAM SMITH and the Commonwealth of Pennsylvania.

The Norman System of Track-Laying.

In answer to certain inquiries regarding the system of track-laying patented by Mr. PHILIP NORMAN, of Shreveport, La., we have the following letter from Mr. H. H. S. HANDY, of Berkley, Va., Train and Road Master of the Norfolk Southern R. R. Co., which has some of this track in use. Mr. HANDY says:

The method in question consists in leaving about ⅛-in. between the spike-head and the flange of rail. The joints are closed tight, and expansion provided for by turning the rails out and putting in a pair of switch-points at long intervals. The principle is easily explained. The great cause of rough track is the continual churning of the tie in its bed, caused by the wave motion in the track between each pair of wheels. To obviate this the spike is left so that the rail can move up and down without disturbing the tie in its bed. The tie is covered with earth to give some additional weight to counteract the lifting effect which friction of the flange against the spike might have.

Where the rail is turned out and the switch-points put in there is a device with a spring which allows movement of rail caused by expansion, but which tends to counteract to some extent the creeping of the loose rail.

We put in one-half mile of straight track last fall under the supervision of the patentee. The track is unballasted and the material used in some places was a light loam, not at all calculated to hold a good surface under ordinary conditions. It was re-tied and re-surfaced in the late fall, and would, in our low, wet country, have been very difficult to keep safe through the winter when worked over so late in the season.

We have done no work on the track in question. It has withstood a rather severe winter, with heavy rains and some hard frosts, and is now substantially in as good line and surface as when put in. Our experience with it has been satisfactory enough to warrant us in extending its use on our road, and the patentee is now in Virginia making arrangements to apply his method on some other roads.

The Fales Hot-Air Furnace.

The Fales hot-air furnace is advertised to save from "one-half to two-thirds of the cost of fuel ordinarily used," a claim somewhat similar to that made for the famous Irishman's stove that only required duplication to save all the fuel. But this furnace is on daily exhibition at No. 11 N. Fifth St., Philadelphia, and it is only fair to give the inventor's claims, incredible though they be. The fuel used is soft or hard coal, coke or coal slack; the combustion is supposed to take place without smoke, gas or clinkers, and a fire once started is said to produce a steady heat for 33 hours without additional fuel.

The grate is peculiar. In appearance it is somewhat like a hat, the body being 8 ins. deep and grated below, and the rim is made of radiating grate-bars. The larger part of the fuel is carried in the body of the grate, and the air current passing through from below is somewhat retarded by the mass of fuel. But a larger volume of air rushes through the grate rim with a very considerably increased velocity. It is claimed that the combination of these two air currents of differing volume and velocity produces a partial vacuum, and causes the central part of the combustion chamber to be many degrees cooler than the outside or the part over the grate-rim, and that this vacuum produces an air-blast of great power towards the center of the combustion chamber.

In practice, the coal is first placed in the fire-pot and ordinary kindling is placed *on top* of the coal and lighted. The coal is lighted, the "suction-blast" is started and "the coal burns from the top downward." The inventor has much to say about the creation, or utilization rather, of a "consuming element," of rotary, cyclonic action, and the consump-

tion of the coal merely as in the wick of a lamp, which, as no one can understand it, is not necessary to repeat. But reliable witnesses say that certain very wonderful results are secured in the way of melting steel and iron, and very rapidly evolving intense heat. And it is claimed that to all appearances no other appliance than the peculiar grate described is used in bringing about these results. It sounds very like a fairy tale of Mr. KEELEY's production, and it is better to await further results. It is so simple in its claimed construction, that it must soon be very apparent whether it is a really a new thing or simply an artfully concealed mechanical trick.

Data Relating to the Mont-Cenis, St. Gothard and Arlberg Tunnels.

Mr. M. J. MEYER, Engineer of the Western Swiss and Simplon Railway, has presented to the Vaudoise Society of Engineers and Architects a tabular statement of the controlling conditions under which the Alps have been pierced at the Mont Cenis, St Gothard, and Arlberg tunnels.

Before presenting the comparative table prepared by Mr. MEYER, it will be well to note the comparative cross-sections of the tunnels treated. The average excavation cross-section in the Mont Cenis tunnel is represented by a circular arch of 26.24 ft. diameter and an extreme center height of 25.58 ft. The St. Gothard tunnel is also 26.24 ft. wide in the clear and is 19.68 ft. high in the clear. The Arlberg tunnel had several types of cross-section, but the average of excavation was about 26.3 ft. in clear width and 25 ft. in clear height. With this data of cross-section, the chief points of general interest in the three great Alpine tunnels are as follows:

General Data Relating to the Mont-Cenis, St. Gothard, and Arlberg Tunnels.

Data.	*Mont-Cenis.*	*St. Gothard.*	*Arlberg.*
Total length { of main tunnel	40,062 ft.	49,147 ft.	33,653 ft.
Total length { with side galleries	42,230 ft.		
Elevation of highest point in tunnel	4,388 ft.	3,785 ft.	4,297 ft.
Elevation of highest point on surface	9,673 ft.	9,384 ft.	5,822 ft.
Greatest thickness of rock overhead	5,285 ft.	5,509 ft.	1,525 ft.
Maximum temperature of rock in the interior	85.00 F.	87.4° F.	69.8° F.
Date of commencing work	South. Aug. 31, 1857	Sept. 13, 1872	East. June 25, 1880
	North. Nov. 16, 1857	Oct. 24, 1872	West. June 24,1880
Date of completion	Sept. 15, 1871	Dec. 31, 1881	May 31, 1884
Time consumed in construction	14 yrs. 38 days	9 yrs. 109 days	4 yrs. 38 days
Tunnel driven by hand	3,377.4 ft.	1,010 ft.	1,860 ft.
Total time consumed in hand-work both sides	3,124 days	455 days	286 days
Average daily advance by hand	1.08 ft.	2.22 ft.	1.67 ft.
Tunnel driven by machines	36,705 ft.	48,137 ft.	31,793 ft.
Total time with machines, both sides	6,506 days	4,894 days	2,189 days
Average daily advance in one heading by machines	5.04 ft.	9.8 ft.	15.7 ft.
Average yearly advance in one heading by machines	1,876 ft.	3,500 ft.	5,400 ft.
Date of meeting of headings	Dec. 25, 1870	Feb. 29, 1880	Nov. 13, 1883
Average advance by hand and by machines in one heading per year	1,518 ft.	3,250 ft.	4,382 ft.
Average advance by hand and by machines in one heading per day	4.25 ft.	8.97 ft.	13.50 ft.
Average advance during last year in one heading, per year	2,667 ft.	3,608 ft.	6,462 ft.
" " " " " per day	7.95 ft.	12.56 ft.	17.80 ft.
Maximum daily advance per heading	9.5 ft.	22.6 ft.	26.2 ft.
Total cost of tunnel	$15,100,000 (a)	$11,708,631 (b)	$8,166,660 (c)
Cost per linear foot	$374 (d)	$238	$243
Total cost of plant	$700,000 (e)	$871,110 (f)	$713,417 (g)
Cost of plant per linear foot	$17.44	$17.72	$21.20

Note. (a) Includes the cost of earthwork and masonry connected with the main tunnel, that of the junction tunnel of Modane, the forfeit of $250,400 which it cost, and the $82,000 expended by the Paris-Lyons-Mediterranean Ry., and also $878,600 spent by this company in 1873-76 in driving another approach tunnel about 4,500 ft. long, and finally $34,000 spent upon the junction tunnel at Bardonèche. It also includes the general expenses, but not the interest on capital invested or the expenses connected with establishing the original line.

(b) Price of tunneling and masonry.

(c) Price of tunneling and masonry, including the ballast, but not including the cost of administration.

(d) Taking 42,042 lin. ft. as a divisor.

(e) This plant includes air-reservoirs, pumps, buildings and pipage of air and water.

(f) This plant includes the engineering, roadway, buildings, mechanical plant, telegraph, fencing, materials of construction of operation and the hospital.

(g) Includes all machinery, but does not include the roadway nor the tools belonging to the rock-drills and their carriages. These were charged to the contractors.

The Causes and Remedies of Boiler Explosions.

Mr. A. J. WRIGHT, manager of the Reliance Gauge Co., of Cleveland, O., contributes to the *Iron Trade Review* the following article, which, though apparently inspired more or less by a desire to "boom" the Reliance safety water column, yet tells well some home truths too often forgotten:

The several recent disastrous boiler explosions, notably those at Hartford, Conn.; Scranton, Reading and Pittsburgh, Pa.; St. Louis, Mo., and Cleveland, O., incurring an average loss of about ten lives, including many women and children, and other people wholly innocent of any responsibility for them, and destroying an average of over $30,000 worth of property, has awakened great interest and anxiety, not only among steam users but also among employés; and, in fact, on part of the public in general. These six appalling explosions all occurred within the short period of four weeks, the first, that at the Park Central Hotel, Hartford, Conn., occurring on February 18th, and the last, that at the West Point Boiler Works, Pittsburg, on March 14th. There were several other explosions within this period, but they were of such an ordinary nature as to be completely overshadowed by those mentioned, which followed each other in rapid succession.

These explosions were exceptional in many respects beside their magnitude. All of them, except the first, occurred in what may be termed first-class plants, all belonging to large corporations, where the boilers are generally well equipped and everything is supposed to be kept in repair, and where the best regulations prevail, one being in a silk mill, one in a colliery, one in a boiler works (which, by the way, enjoyed an enviable reputation for first-class work), one in a rolling mill, and one in a large flour mill. The newspaper reports also show that nearly if not all of these boilers, excepting in the hotel at Hartford, where there was a combination of enough ignorance, carelessness, false economy and negligence to place this average also above the ordinary, were insured, and inspected periodically, as all boilers should be, and in at least two of the cases city inspection also prevails. What then is the cause? The annual report of the Hartford Steam Boiler Inspection and Insurance Co. for 1888 shows that the inspectors of that company, in addition to 168 cases of deficiency of water, 54 of which were dangerous, found 1,702 burned plates, 255 of which were also reported dangerous. In other words, the inspectors of this one company found 309 boilers, which were in immediate danger of exploding, no matter how full of water, as a result of the water having been low at some previous time. When in this connection we consider the fact that this is only the report of one company, and, again, that only a small proportion and the best of the boilers in use are insured, and that there were, according to this company's reports, 8,658 other cases of danger found during the year, among the number being 473 dangerous cases of incrustation or scale, 306 cases of broken stays and loose braces, 178 defective settings, 1,588 cases of defective riveting, 417 cases of leakage at the seams, and 2,065 dangerous cases of leakage around tube ends, 238 cases of defective water gauges, 146 cases of overloaded and 176 cases of safety valves defective in construction, 361 cases of defective pressure gauges, and 92 boilers without pressure gauges (!) and several hundred miscellaneous defects—a total of 8,967 cases of defects where there was absolute danger of immediate explosion—it must be agreed that the only strange thing about the frequency of boiler explosions is that they are not more frequent.

There were 1,702 burned plates, 255 of which were dangerous; 15,122 cases of "serious leakage around tube ends," "dangerous," 2,065; 4,552 cases of "serious leakage at seams," "dangerous," 417; in addition to 168 cases of "deficiency of water," 54 of which were "dangerous," all of which weakened and shortened the lives of the boilers.

It is not improbable that a large number of these, nearly 20,000 cases of leakage around the tubes and seams, were caused by unequal expansion due to low water at some previous time. Is it not a reasonable conclusion, therefore, that the water becomes low much more frequently than is generally supposed, and that it is the indirect cause of many boiler explosions not attributed to it, and that many competent and faithful engineers and firemen suffer, as a result of the ignorance or negligence of their predecessors.

Furthermore, we have evidence other than theoretical tending to the same conclusion. The experience of steam users with Reliance safety water columns is that they whistle for low water about once a month, on the average, even where the best help and most perfect regulations prevail; and to this fact is largely due the action of many of the large corporations in throwing out the ordinary combination and equipping all their boilers with these appliances, after learning their value through practical experience. It is clear that the water in steam boilers becomes low oftener than most people suppose, likewise that the boiler is weakened more or less every time it becomes low, and there is no room for doubt that it may ultimately give way with plenty of water in it and even without the contributory assistance of ignorance, negligence, or even over-pressure, in which event it is no less the result of low water than if it had occurred when the water was low.

Both the insurance and safety water columns have a like effect on the employés, which is of the utmost importance. They make those who might otherwise be careless or indifferent, watchful and careful, for any negligence is sure to be reported to the proprietor either by the inspector or the whistle. This extra watchfulness is of itself of vast importance and will go a long way toward preventing "mysterious explosions" and solving the problem of safety.

Foreign Railway "Luxuries."

The "Service de Luxe" on the French railways is not recommended to travelers by a correspondent of the London *Standard*. He says that he was lately one of a party who paid $25 extra apiece for the privilege of sleeping on the floor of the dining car, and then reached his destination four hours late. The ordinary "Service Rapide" of these lines is excellent, for Continental railway management; but the so-called sleeping coaches are as far behind the American type, in real comfort, as the ordinary divided day carriage with its side entrance is behind the cars on a "vestibule train."

Another outraged correspondent of the same *Standard* relates his experience on the Orient Express. He complains of insolence of the guards, lack of attention to his baggage, nothing to eat, late trains, etc., all in a style that is very English. But his chief and proper grievance is that whereas he paid $3 extra between Belgrade and Pesth for the supposed privilege of occupying a sleeping berth, he was kept in a dingy waiting-room for about one hour while his car was standing in the station, and he might have been enjoying a nap of an extra hour. In fact he did not get to his bed until 4.30 A. M.

THE SIMPLON TUNNEL CONCESSION has been bid for by an English syndicate, according to foreign reports. The syndicate claims to have a capital assured of $18,000,000.

The Electrical Treatment of Sewage.

The electrical treatment of sewage according to the system of Mr. WILLIAM WEBSTER, of London, has been before referred to in this journal, but the first practical demonstration of this method on a working scale was recently given at the main drainage outfall at Crossness, and is substantially reported as follows in *The Engineer*.

The physical success of Mr. WEBSTER's method was proven sometime ago, so that the late experiment was only necessary to show that the process could be carried out in practice without excessive cost. Mr. WEBSTER here dealt with a flow of sewage equal to 12,000 galls. per hour, though it is believed that, owing to the limited ground at his disposal, better results yet can be obtained.

The invention of Mr. WEBSTER is described as an improved mode of electrolysis for oxidizing and precipitating organic matter and decomposing inorganic salts, such as chloride of sodium, potassium, magnesium, etc., and all salts contained in sewage. For this purpose he subjects the liquid while flowing through channels or weirs to the electrolytic action of positive and negative electrodes made of iron and having a very extended surface. Ammonia and other alkalies are evolved at the negative electrode, and assist the precipitation of the iron salts formed at the positive pole, where at the same time nascent oxygen and chlorine are

evolved, partly acting on the iron and producing an acid reaction, whereby the organic impurities in suspension are precipitated, while those in solution are oxidized and converted into harmless compounds. Of course the nascent chlorine will have much greater efficiency than the chlorine present in chloride of lime, and the nascent oxygen will have much more effect on the organic matter in the form of albumenoids than the oxygen of the atmosphere.

In the Crossness experiment the plant occupied an area of 260 ft. by 60 ft. There were two settling tanks of ordinary form, in line, and at the end of the last tank was a precipitating tank with iron electrodes. Alongside the latter were two engines, arranged to be used independently for running a dynamo and the sewage pump. Running almost the entire length of the 260 ft. was a series of three shoots, arranged one above the other in step fashion and provided with iron electrodes. The upper end of this series of shoots connected with the sewage pump, and the lower end with the settling basins, entering the latter at the dam separating the two basins. The precipitating tanks first mentioned practically form no part of the present working arrangements; they were experimental only, so as to discover the best method of arrangement and would not be repeated in future works.

The shoot is the electrolytic channel in which iron electrodes are suspended from cross-bars supported on the sides of the wooden shoot, which latter would be of stronger material in practice. The electrodes were simply wrought-iron plates; but in future cast-iron would be used, run direct from the blast-furnace. As the sewage travels along the shoot, every particle of the liquid comes in contact with the plates and is subjected to the electrolytic action. A separation of the solid particles from the actual liquid speedily takes place, increasing in intensity as the sewage approaches the settling tank.

Each of the portable engines is of 20 H. P., and only one engine is used at a time for pumping and driving the dynamo. The dynamo is an Edison-Hopkinson capable of developing an energy of 43 H. P. From the dynamo the leads run through resistance frames, by means of which the amount of current passing to the electrodes can be regulated without varying the speed of the engine. According to Mr. WEBSTER, it is possible with 27 H. P. to treat one million gallons of sewage in 24 hours, presuming the sewage to be of the same strength as average London sewage. In estimating the cost, the coal consumption is taken at 2 lbs. per horse-power hour. The consumption of iron should not exceed 2 grs. per gallon of sewage and plates 1 in. thick should last for a number of years. To illustrate, he says that a town of 330,000 inhabitants, with a sewage output of 10,000,000 galls. per day, should not consume more than 464 tons of iron per annum. The amount of mechanical power required per head of population is shown to be $\frac{1}{10}$ H. P., or 8 H. P. per 10,000 inhabitants. A very small electro-motive force, only a little over 2 volts, is used and about 11 sq. ft. of iron electrode surface per ampère.

Running from the shoot, and allowing one hour for settlement in the open tanks, the average of 20 analyses shows that under this treatment raw sewage of a very turbid and opalescent character yields a clear and odorless effluent. Estimated in parts per 100,000, the suspended matter is reduced from 33.35 to 1.56. Nitrogen, as free ammonia, is reduced from 4.34 to 3.22 and albumenoid matter from 0.5 to 0.2. Chlorine as chlorides becomes 18.62 instead of 21.64, and the oxygen required to oxidize the organic matter becomes 0.52 instead of 1.34. A sample of raw sewage, very turbid and opalescent, and with a bad odor, yielded a clear effluent without odor. The sewage contained 14.52 parts of suspended matter, 5.95 being mineral, and 8.57 organic. In the effluent these quantities became respectively 148, 1.05, and 0.43. The free ammonia declined from 3.57 to 2.9, the albumenoid matter from 0.6 to 0.28, and the chlorine as chlorides from 14.61 to 13.39. The oxygen required to oxidize the organic matter was 4.08 in respect to the sewage, compared with 1.34 for the effluent.

The disposal of the sludge is a final consideration in this as in other processes where precipitation takes place. But the sludge from the electrolytic action is not swollen by the admixture of any foreign ingredients beyond one or two grains of iron per gallon, which as oxide becomes somewhat more.

In the course of the day's proceedings Mr. WEBSTER stated that he estimated the working cost of his process at $3.12 per 1,000,000 galls. of sewage treated. This was irrespective of interest on capital, and the allowance to be made for depreciation, except that it included the waste of iron. On 150,000,000 galls. per day, representing the whole of the London sewage, north and south, at the present time, the cost at the rate above-named would amount to $180,000 per annum. Mr. WEBSTER, in reply to various questions, said he had not undertaken any calculations as to anything beyond the working cost. He subsequently stated that the charge for interest on capital and depreciation of plant would not be likely to exceed $25,000 per annum.

Railway Terms in England and America.

The London *Railway Press* speaks as follows of the different terms used in connection with railroads in the two countries under discussion:

It seems strange and peculiar to many readers of railway newspapers to observe the difference of terms used by England and the United States, when speaking of the various appliances in use, or speaking and writing of railways themselves. These terms, though of the English language, are widely different. In the present article we will not attempt to prove which are proper, but will content ourselves with pointing out some of the most prominent, leaving our readers, "with a few suggestions," to judge for themselves as to which they think most suitable. The gradual growth of communication between the two countries, the interchange of materials, and various other things, make it instructive to read the terms side by side, with a view to enlightenment. The science of the exact use of technical terms or phrases is sadly neglected in this country, and railwaymen are left to flounder about, and in many instances judge for themselves as to the right meaning. What in this country is a railway, in the United States is a railroad. Tramways are there called street railways, an engine is always called a locomotive, a driver is a locomotive engineer, railway carriages are cars, a guard is a railway conductor, and a station is a depot. There are a number of other minor terms employed in the two countries, showing a wide difference, but the few enumerated above are most conspicuous. It would seem that the proper use of railway terms, and in fact of all technical terms appertaining to any science, business, or industry, should depend upon their exactness of definition and signification. A word should be obtained for everything—that should mean one thing and no other—and for this purpose an examination of the various terms used by the two countries will enable the reader to judge which possess the desired exactness.

In the first place, it would be advisable to ascertain which have the greater adaptability; by this means we shall be able to decide the merits between terms in other respects pretty equal. We will begin with the general terms "railway" and "railroad." Either word at once defines itself, and there can be no question as to their meaning; a railway is a railroad, and a railroad is a railway. Both being equally expressive, the only question to be settled is upon the adaptability. It is now universal to use the expression R. R. for the purpose of abbreviation in the case of railroad; but with railway the abbreviation Ry. is certainly better, and more easy of pronunciation. Passing on we come to the terms "engine" and "locomotive," and here, we think, our American cousins have the best of it; the word "engine" is not definite enough to express the meaning, whilst the word "locomotive" expresses plainly everything desired, and settles the question as to its being an engine capable of moving from place to place. There is nothing about the word "engine" that is distinctly applicable to railways, but the reverse is the case when using the term "locomotive."

The next term is "driver," with the Americans "engineer;" the former of the two would seem the one better suited to the man whose mechanical occupation is to drive. The word "engineer" has a tendency to confuse, when used instead of "driver." An engineer should be either a civil or mechanical engineer: the term is, or should be strictly scientific. In this case the palm falls, in our opinion, to us. The terms "stoker" and "fireman" is another example: the former is the more definite; it is a good old English word, derived from *stoke*, a stick, signifying one who rakes or sticks a fire, and thus tends it. But the word "fireman" is not at all definite when used in this case; "fireman" generally conveys the impression of a member of some fire brigade: this latter term is gradually creeping in, and in many parts of England it is used exclusively.

Passing on, we will notice "guard" and "conductor;" these terms are used to signify the person in charge of a train or car. Neither term seems at all definite, the former especially. It is not the duty of a railway "guard" to *guard* the train, so much as to superintend it and control it within certain limits. "Guard" is a word in universal use, its signification being "one who exercises watchful care." "Conductor," also, is a word in general use, but of the two is preferable to "guard." "Carriage" and "car" next claim our attention, and for comparison the Americans seem to have the best of it; the words are in exact signification, and pretty much the same thing, the word "carriage" being used for many kinds of vehicles in England, for road and rail, with the exception of tramcars, and this latter term would seem to have crept in from across the Atlantic, probably owing to its general use in the States prior to its introduction here. But for simplicity the word "car" is by far the better and could with advantage be used to specify passenger vehicles used on railways as well as tramways.

Lastly in this article we will call attention to the words "station" and "depot;" the former will be conceded to be the better from every point; "depôt" means simply a magazine or storehouse, neither of which a "station" represents. In the general superiority of terms, England seems to have the advantage. Many of these terms are being recognized by our American cousins, but the same cannot be said of us, for we are not so readily disposed to concede the superiority of the few American terms which we think are undoubtedly the best; but, like true Britons, the idea of a change is viewed with horror. The time may come when a uniformity of technical terms will be used by all English-speaking people; but he who sets himself to effect a modification will have a most difficult task. Time alone will alter and modify railway terms.

The Electro-Matrix Printing Machine

A new invention, designed to do away with much of the manual labor involved in the composition of type for printing newspapers, books, etc., has been perfected by the Minneapolis Electro-Matrix Co., which is very interesting as opening new possibilities for improvement in this oldest and thus far most unchanging, although most expensive, part of the art of printing. Since printing with movable type was invented, no type-setting or type-distributing machine which would take the place of the compositor's manual work in picking up the thousands of separate bits of type, has been practically successful in general use, although many ingenious machines, to perform the automatic part of the work, have been tried with a varying degree of success. The electro-matrix machine embodies a new idea, and applies the wonderful power of electricity to the attainment of its result.

The machine is about 8 ins. in width by 2 ft. long, and sets upon a stand in a similar manner to the ordinary sewing machine. It is the joint invention of Mr. A. S. CAPEHART, who was employed as a type-setter on the Minneapolis *Tribune*, and of Mr. GEO. A. GOODSON, of Minneapolis, an electrician.

Upon an iron plate 6 ins. square in front of the operator, are placed 92 characters used in a font of type, including the letters of the alphabet, and contiguous to each of these characters is a small hole or depression in the plate. An index point held in the hand is connected by a flat bar, pivoted and sticking horizontally on two guide rods in such a manner as to make a universal joint, so that no matter to what point on the iron plate the index is moved, the rear end of the bar will move to a corresponding point. Attached to the rear end of the bar is a plate punched with holes and carrying in them, held up, by small spiral springs, steel dies, each having one of the type characters engraved upon it. This plate rests upon a polished steel die plate, which has a single hole in the center of the proper size to allow any one of the dies to drop through it. By means of the double motions of the flat bar, on placing the index in any one of the depressions in the front plate, the corresponding die bearing the same letter or character is moved to the central position directly above the hole in the die plate. The arrangement thus far is similar to that of the Hall typewriter.

Above the die thus placed are two short arms or levers forming a vertical toggle joint carrying an armature, and just behind is an electro-magnet, which, when an electric current is sent through it, attracts the armature and straightens the toggle joint driving the type die through the plate upon a platon beneath. The machine is driven continuously by a small electric motor of about $\frac{1}{20}$ of a horse power. When movement of the index is made to any letter, an automatic device causes the

toggle to strike one blow only, and then stops until it is moved elsewhere.

The impressions are received upon strips of moist papier-maché of thickness similar to blotting paper, and of a width equal to the width of a column in a newspaper or the page of a book.

The strips, as taken from the machine, have clear, sharp-cut impressions of the type, and are used in a stereotyping mould as usual, as a matrix for making the stereotype plates. Examples of the work done show the quality to be as good as that from any type.

It is stated that the machine, under a fair operator, will set easily 5,000 ems per hour. It does away with type-setting (as ordinarily understood) and type-distributing, which latter, it is said, causes 80 per cent. of the errors made in ordinary composition. It does not require the possession in an office of large fonts of type, and the matrixes are much lighter, and occupy less space in preserving book plates, than even stereotype plates. Spacing, adjusting lines, etc., is accomplished by automatic electric devices, as in a typewriter.

Although errors in composition, punctuation, etc., can be corrected by repeating a line and sawing out the line containing an error, in the stereotype plate, it is easier and less expensive to correct them in manuscript by providing a correct typewritten copy of the manuscript to be copied exactly by the electro-matrix machine operator.

As to the cost of composition by the new method a sufficiently long trial of these machines has not yet been had to determine what this will be ultimately.

The parent company, at Minneapolis, leases the machines to several sub-companies. The New England Electro-Matrix Co. has a capital of $1,000,000 stock, par $100. One hundred machines are building for this company at the Ames Manufacturing Co., Chicopee, Mass. It is proposed to lease the machines at $500 apiece, with a royalty to be paid in addition, of 10 cents per 1,000 ems. Mr. E. H. STEELE is President of the Minneapolis, or parent Company, THEODORE C. BATES and Mr. C. M. GAGE, of the New England Company, with offices in the Equitable Building, Boston.

One of the most important operations in composition is that of "justifying," or setting the type so that all the lines are of an equal length and the words evenly spaced, whether the words be long or short. This has always been a difficulty to be overcome in all forms of type-composing machines, and a point in which many of them have failed.

The ordinary typewriter does not justify, but the copy prepared on a typewriter for the electro-matrix machine is easily fixed so that each line is justified, as printed on the matrix, as follows: The typewriter who prepares the copy is informed how many units (ems) are to make up each line in the newspaper columns or book page. Suppose this number is 140, made up of letters forming the words, and the spaces between the words. After writing each line with the typewriter, the operator counts the units, and if this is, say 144, in any given line, he runs the machine back over the line and prints—4 at the beginning, to show that 4 units are to be deducted from the line as printed. Should another line run 132, the figure 8 is prefixed. In following the copy on the matrix machine line for line, in the latter case the operator either puts in a short word, if there is room for the next word of the succeeding line, or uses up the eight extra spaces, in the spacing of the line, as he prints with the dies. The typewriter may also be arranged to indicate the justification electrically, with a differential feed of units for different letters, on the same principle on which the matrix machine is arranged.

As to the success of other machines for composing type, it is understood that the New York *Tribune* has fifteen or twenty in use, for a portion of its work. This machine is called the Merganthaler or Linotype machine and has been in extensive use about one year. Other papers, the Louisville *Courier-Journal* and the Chicago *Daily News*, have used such machines; but, it is said, the cost has been greater than that of composition in the ordinary way. Allowance should be made for enthusiasm, but the matrix people affirm that they can furnish the stereotype plates, finished ready for the press, at 25 cts. per 1,000 ems, or not much over one-half the present cost of ordinary newspaper composition.

Hydraulic Formulæ: A Correction.

SCRANTON, Pa., April 4.

TO THE EDITOR OF ENGINEERING NEWS:

Mr. BUCK, in his communication of March 30, kindly calls attention to an error in the example of a series of branch pipes discharging from a main, given in my paper on "Long Pipes" in your issue of March 16, at the head of the first column of page 233.

Mr. BUCK is perfectly correct in his figures; the subtraction of h, h', etc., should be confined to the different sections of the main, and not applied to the branches also, as was inadvertently done in the example cited.

The successive values of the piezometric heads should be as Mr. BUCK stated:

h	= 7.32	instead of	8.13
h'	= 16.42	" "	18.51
h''	= 29.60	" "	32.05

The quantities discharged should be:

Q	= 122.05	instead of	128.61
q	$= \frac{14.30}{136.35}$	" "	$\frac{15.97}{144.58}$
Q'	= 136.10	" "	145.32
q'	$= \frac{27.62}{163.72}$	" "	$\frac{19.81}{165.13}$
Q'	= 163.75	" "	166.04
q''	$= \frac{39.72}{203.47}$	" "	$\frac{24.24}{190.28}$
Q''	= 203.75	" "	191.16

The differences between these figures are very suggestive. We see that a considerable error was made in working the original example, the discharges through the branches being erroneously calculated as if for falls respectively of 4.13, 6.38 and 9.54 in 500, instead of 3.32, 12.42 and 25.6 in 500. It would appear, at first sight, as if these greatly changed conditions would produce a great change in the discharges, but we see that they are on the contrary diminished only in a comparatively slight degree, the difference in the total volumes discharged being only about 6½ and 6⅝ per cent, while the discharges in the lower half of the system are actually increased, the gain in the 4-ft. main being greater than the loss in the 2-ft. branches.

It will be appropriate here to bring into greater prominence than was done in my original paper the fact of the comparatively small influence of *grade* in the volumes discharged through a long pipe, and the dominating influence of *diameter*. To exhibit this more fully, referring to formulæ (13) and (14) on page 234 of same issue (March 16), we find that for a diameter of 1 ft., and a fall of $\frac{1}{1000}$, the volume of discharge is 1 cu. ft. If we wish to double this discharge by increasing the fall, we must adopt a grade of $\frac{4}{1000}$, *i. e.*, we must quadruple the fall. If, on the other hand, we wish to produce the same result by increasing the diameter without changing the grade, we need only adopt a diameter of 1.32 ft, and even a little less, on account of the decrease in the coefficient. That is to say, to double the discharge, we must increase the fall 300 per cent., or the diameter 32 per cent.

I will take this occasion to say that in the large number of calculations and examples given in my paper on "Long Pipes," some further errors may perhaps have escaped my notice. I would esteem it a favor if your readers would lend me their co-operation in correcting such faults, by communicating to your columns any which they may detect.

E. SHERMAN GOULD.

Perkins and Other Tie Plates.

NEW YORK, April 4, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

The enclosed letter, just received, may be of interest to you. Use it (and that below) if you desire. Its evidence is to the same effect as what I have known personally (as well as heard) to be the facts on several roads. The writer asks me:

"Is there not another cause for rails cutting or chopping into the tie than weight and passage of engine and train? Is there not a limited longitudinal movement of the rail acting as a rasp that causes the fibres of the wood to separate, and after being cut off by the edges of bottom of rail, to work out on the side of the tie?"

I have noticed this fact in several instances and cannot account for pieces working out unless from movement of the rail as suggested.

Yours truly,
ROBERT L. HARRIS.

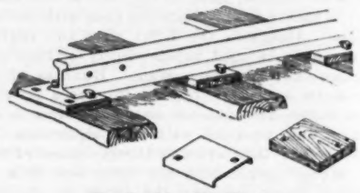
[The letter enclosed is as follows.—ED.]

PORTSMOUTH, N. H., April 1, 1889.

ROBERT L. HARRIS, C. E.

Dear Sir:—I have read your letter in ENGINEERING NEWS of March 23, with the editorial comments thereon. . . .

In regard to the editor's comments, I can only say that after 5 years' trial of the "Perkins Chair" I have yet to discover any indications of "rot" in either tie or chair. The chairs have been down on Delaware, Lackawanna & Western R. R. on main line 5 yrs. 6 mos. on soft and hard-wood ties at different points, some of them at a point just beyond the tunnel where two tracks cross each other. These chairs were of our first manufacture, size 5 x 6½ ins., which I do not recommend; but I do recommend our 6 x 7 in., with wood projecting ¾ in., which gives a bearing surface of 51 ins. The top surface of the wood plate is scarfed at each end (by machinery), outside the bearing surface of the rail, equal to what the compression of wood would amount to, which arrangement prevents any tendency in the iron plate to cock up or break. The Road Master (of 30 years' experience) would take pleasure in showing you the location of these chairs, and would remove any of them for examination of the tie for rot.



The Perkins Tie-Plate.

About two years ago I sent fifty of our chairs, made as they should be, to the New York & Hudson Canal & R. R. Co., at Albany, N. Y. Last fall I wrote the road to know if they were in use. The chief engineer replied that the chairs were received and placed in track about one year ago, and a recent personal examination disclosed no perceptible change in ties on which the chairs were placed, while on contiguous ties, with the same travel, the wear was most perceptible.

At 64 Reade St., New York, Mr. E. H. AUSTEN has a section of one of the kyanized hemlock ties, examined by us at North Beverly, Mass., which was in the track, with our chair on it, four years. The tie was preserved at B. & M. works this city (Portsmouth, N. H.).

Yours very truly,
M. R. PERKINS.

[To make this letter clearer, we reproduce from our issue of March 23 the cut of the Perkins tie-plate; and we give with pleasure the above explanatory details, which certainly go to indicate that the tie-plate does not cause rot. But if not, why is it not in more general use?—ED. ENG. NEWS.]

Graphic Rivet Symbols.

PHILADELPHIA, Pa., April 3, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

Referring to the communication in your issue of March 23, on "Rivet Signs," the writer would say that his understanding of the expressions "inside" and "outside" is the reverse of that assumed by Mr. WAGNER. "Inside," as understood, means between the object drawn and the draughtsman. "Outside," on the side of the object drawn, beyond the draughtsman. This interpretation of the terms is always applicable; while, if it were understood to mean "inside" or "outside" of a closed member, its application would be extremely limited, and in some instances incorrect; thus a single plate girder would have no "inside." The expressions are misleading and should be avoided.

This ambiguity, however, is not the only objection to the "Osborn Code." The fact that it is more conventional than graphical is to the writer's mind its chief defect. We naturally hesitate to abandon correct signs for conventionalities, unless there is some decided objection to that which is correct.

Shop drawings are made for the construction of work in the shop, and are rarely, if ever, sent into the field for erection. Erection diagrams are drawn to a reduced scale and do not show rivets. Therefore, in shop drawings, we show *holes*, not "field rivets."

A rivet hole, countersunk on reverse side, is shown graphically by a blackened hole, surrounded by a dotted circle. The signs for shop rivets may be added, if desired, for conventionality; but the outer circle cannot be solid, and at the same time conform to the principles of graphics. The objections to the additions of the signs for countersunk rivets to holes are:—1, the original derivation of the crossed rivet-head, as indicating a tendency to split at the edges, *is not applicable to a hole*; and 2, when the hole is drawn to scale, the space between it and the outer circle is too small to insert any distinct signs between them.

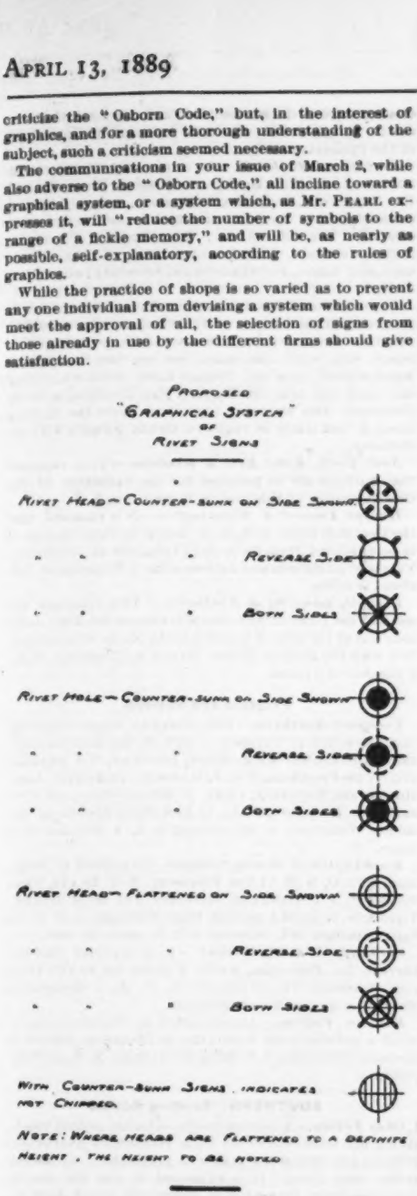
A further objection to the "Osborn" system is the use of vertical lines. How does a vertical line represent a flattened head? In this code a single vertical line *on the center line of the rivet* is made to represent a rivet "countersunk and not chipped"; or worse, two little vertical lines, outside of the rivet-head, *and again on the center line of the rivet*, are made to represent a rivet "countersunk on reverse side, and not chipped." A glance at these signs, as published in your issue of March 2, will show the objections in this respect.

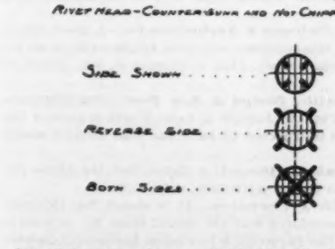
It was not the writer's intention to discourteously

criticise the "Osborn Code," but, in the interest of graphics, and for a more thorough understanding of the subject, such a criticism seemed necessary.

The communications in your issue of March 2, while also adverse to the "Osborn Code," all incline toward a graphical system, or a system which, as Mr. PEARL expresses it, will "reduce the number of symbols to the range of a fickle memory," and will be, as nearly as possible, self-explanatory, according to the rules of graphics.

While the practice of shops is so varied as to prevent any one individual from devising a system which would meet the approval of all, the selection of signs from those already in use by the different firms should give satisfaction.





We find among those published by Mr. SCHNEIDER, March 23, many signs which would, in all probability, give excellent practical results; but of these, there are several which conform so closely to the requirements of graphics as to render their selection desirable. For flattened heads, the signs of the Dominion Bridge Co. are graphically correct and self explanatory. For countersunk holes, those of the Pencoyd Iron Works are equally correct. For countersunk heads, the selection is not so clearly defined, but those of the "Osborn" system, or those of Edge Moor, appear to have met with preference. The former seems rather the neater and the more satisfactory, since the side on which the head is countersunk is more readily distinguished at sight; but in the sign for "countersunk on side shown," the lines should preferably not meet at the center, as the sign is thus mistaken for "countersunk on both sides." For distinctness, the lines may be made heavy.

The Edge Moor signs may be advantageously used, in addition to these, as indicating "not chipped."

These signs have been combined, with the suggestions made through your columns, to form a "Graphical System."

Very respectfully,

HENRY B. SEAMAN.

Hydraulic Formulæ: A Query.

LAKE VILLAGE, N. H., March 30, 1889

TO THE EDITOR OF ENGINEERING NEWS:

In looking over the articles on hydraulic formulæ by Mr. E. SHERMAN GOULD, it seems to me he has fallen into error in the solution of the first problem he proposes on page 233 of the issue of March 16, 1889. Adopting his statement and lettering complete, it appears that he solves the problem on the assumption that the discharge of the second branch from the end of the main will be that due to head $h' - h - 4$, the 4 ft. being the amount of ascent in the branch. Now there is no reason for deducting h to get this head on the second branch, but the effective head on the second branch must be $h' - 4$ simply. In like manner the effective head on the third branch is $h'' - 4$, and not $h'' - h' - 4$ as taken by Mr GOULD in his solution. Working the solution by this method, and assuming $h = 7$ to start with, we shall get (neglecting the coefficients as does Mr. GOULD):

$$12.56\sqrt{4\times7} + 3.14\sqrt{2\times3} = 12.56\sqrt{4(h'-7)}$$

or

$$8\sqrt{7} + \sqrt{6} = 8\sqrt{h'-7}$$

$$2.64 + 0.31 = \sqrt{h'-7}$$

$$2.95^2 = 8.70 = h' - 7$$

$$h' = 15.70$$

Next

$$8\sqrt{8.70} + \sqrt{2\times11.70} = 8\sqrt{h''-15.70}$$

$$2.95 + 0.60 = \sqrt{h''-15.7}$$

$$3.55^2 = 12.60 = h'' - 15.7$$

$$\therefore h'' = 28.30$$

Lastly

$$8\sqrt{12.60} + \sqrt{2\times24.3} = 8\sqrt{h'''-28.30}$$

$$3.55 + 0.87 = \sqrt{h'''-28.30}$$

$$442^2 = 19.54 = h''' - 28.30$$

$$\therefore h''' = 47.84$$

But h''' should = 50.00, hence by proportion we find,

h	approximately =	7.00	really =	7.32
h'	" =	15.70	" =	16.42
h''	" =	28.30	" =	29.6
h'''	" =	47.84	" =	50.0

Mr. GOULD'S quantities prove themselves all right, because he calculates them for the same erroneous heads on the branches, which he uses to calculate the values of h h', etc. He has, in fact, solved the problem properly for such a condition as would involve a rise of 4 ft. in the first branch, a rise of 12.13 ft. in the second branch, and a rise of 22.51 ft. in the third branch, instead of a uniform rise of 4 ft. for each branch.

Very truly yours,

W. E. BUCK, C. E.

The Price Frogless Switch.

Allegheny Valley R. R., River Div.
PITTSBURG, Pa., April 2, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

I cannot give you a better idea of the operation of the frogless switch than to let you see a model of it, which I have accordingly shipped to you. It should reach you as soon as this letter does, and soon enough, I hope, for the purpose for which the information is desired.

You will see that on the rare occasions when it may be necessary for a main track train to run through the frogless switch when the latter is in the siding position, the inside guard rail (which has a spring on its actuating rod) is pressed inward slightly by the wheel flanges, just as the loose rail of the ordinary spring rail frog is at present thrust aside by each wheel flange of every car that takes siding over it. When a train of 40 freight cars takes siding through the present frog, its loose rail is thus thrust aside 160 times by the car wheel on one side of the train, besides the tank wheels, drivers, and pony wheels. This is being done every minute in every hour n every day in the year, on some one of the thousands of spring rail frogs to be found all over the country. In the frogless switch, the equivalent operation would be performed perhaps once in five or ten years, under circumstances of careless operation; perhaps it would never have to be done at all.

While the wheel flange is thus pressing aside the inside rail of the frogless switch, the wheel tread is ascending the slope of the main frog casting, gaining the required height of 2 ins. in a length of 8 ft., and afterwards descending the slope of the front casting (or bent rail), resuming the level of the rail in a distance of 7 ft. These inclinations are not very steep ones; yet, to a train running through a switch at high speed, their effect would certainly be noticeable. But bear in mind that the speed would, in all probability, be checked at sight of the red target; and also that this sudden rise is no greater than is required in taking siding over a Wharton switch where the wheel flanges ride over the unbroken main rail in a precisely similar manner, the outer edges of the wheel treads being elevated by the "bridge rail" fitting against the outside of the main rail until the flanges clear the rail; and this is necessarily done, in the Wharton case, on the *inside* of the curve leading to the frog (where you should properly have depression rather than elevation). Yet passenger trains and freight trains are hourly taking siding over the thousands of Wharton witches that are in u on a large portion of American railroads, and the sur attending the operation is rarely noticed, even by railro men, and perhaps not at all by the general class of passengers.

Whatever disadvantag the Wharton switch, as a means of taking siding, may b thought to possess, is held by many railroad men to be counterbalanced out of sight by the great advantage of an unbroken main track which it affords; and so I hope it may some day be said of the frogless switch, that the chance of a noticeable jolting on the rare occasions when, by error, it happens to be run through by a main track train, counts but little as against the greater ease with which trains can take siding over its practically continuous surface as compared with the jerking of the loose rail of a spring frog or the steady bump of an open frog; and, that it is nothing as compared with the smoothness of the absolutely unbroken main rail, which it gives to through passenger and freight traffic at the point where the frog now stands in the way, and demands tribute, in the way of useless friction and wear, from every wheel that passes over it.

Having no personal experience in manufacturing, my views as to probable cost of these switches would have little value, but a friend who is better posted, and who has gone over every item of material, tells me that if made in large numbers, the actual cost at present prices of labor and material ought to be about $61, which includes everything from the heel of the main frog casting to the switch stand, but does not, of course, include the switch. I think it might be well to add 25 per cent. to this estimate.

The movable castings have so far been made of steel, by the Pittsburg Steel Casting Co., of this city; but the smaller or front casting might readily be replaced by a bent rail, and I agree with many who have seen it that in place of the larger casting, there might be used two small pieces of steel rail, planed to proper shapes and bolted together on a plate, very much like the main portion of a plate frog. But I have little or no time to spend in further improvements, and will probably let the matter rest just as it is. If any one chooses to take the matter up where I have left off and push it along to a finish, they are welcome to do so. I realize that I am only a pioneer, and expect nothing but the honorable mention of being one.

Very truly yours,

CHAS. B. PRICE.

PERSONAL.

Mr. H. S. WELLS has been appointed Street Commissioner at Ft. Edward, N. Y.

Mr. A. M. WHITNEY, of Duluth, Minn., will be Superintendent of Water-Works at Green Island, N. Y.

Mr. LEVI BEDELL has been appointed Street Commissioner for the village of Coxsackie, N. Y.

President WILLIAM CALLERY, of the Pittsburg & Western Railway Co., died at Pittsburg, Pa. He was about 68 years of age.

Mr. F. J. SPEYER has been appointed Roadmaster of the Louisville, St. Louis & Texas, between Cloverport and West Point.

Mr. C. M. COOK has been appointed Engineer of Maintenance of Way of the Buffalo, Rochester & Pittsburg Ry., with office at Bradford, Pa.

Mr. W. W. WELLS, Superintendent of the Cincinnati Southern Division of the Queen and Crescent system, died suddenly, April 3, at Somerset, Ky.

Gov. JOHN C. BROWN has sent his resignation to the managing committee as President of the Texas Pacific Railroad Co.

Mr. N. S. RAY has accepted a position as Division Engineer on the R. W. & O. R. R., with headquarters at Watertown, N. Y.

Gen. BIRD W. SPENCER, late Treasurer of the Erie road, has been appointed State Railroad Assessor of New Jersey, succeeding ED. BITTLE.

Col. RICHARD LONG, Treasurer and General Manager of Long's Truss-Rail Joint Co., was run over by a train at Pittsburg, April 4, and killed.

Mr. ALLEN, for many years Chief Engineer of the Denver City Water Co has resigned. He will be Chief Engineer for the new Citizens' Water Co.

Mr. ANDREW J. COOPER has been appointed City Engineer and Commissioner of Highways at Easton, Pa., and Mr. J. A. SMITH has been appointed Assistant Commissioner of Highways.

Superintendent H. M. MCCRACKEN, of the Louisville, St. Louis & Texas, will attend to the duties of Chief Engineer J. H. SAMPLE, who has resigned to go to Florida to reside.

Prof. O. H. MITCHELL, Ph. D., of Marietta, O., died recently. He was one of the ablest mathematicians and astronomers in the country, and the author of several scientific articles.

Mr. DANIEL ULRICH, who for several years has been civil engineer on the Buffalo & Niagara Falls branch of the Erie system, has resigned, and will engage in civil engineering with Mr. GEORGE REIKER, of Buffalo, N. Y.

Mr. JOSEPH MCKROWN has been appointed General Roadmaster of the Indianapolis, Decatur & Western road vice J. DIDDLE, who goes to the eastern division of the C. I. St. L. & C.

Capt. A. CROSS, for some time the Superintendent of the Texas Western, has gone to the mouth of the Brazos, having accepted a position as one of the engineers of the work going on at that place.

Mr. A. J. DIDDLE, Roadmaster of the Indianapolis, Decatur & Western, has resigned and accepted a similar position with the Big Four. He will have charge of the division between Cincinnati and Indianapolis.

Mr. WM. HARRISON, C. E., of Cincinnati, O. died recently. He served for seventeen years in the City Engineer's Department, and made all the surveys for the Cincinnati & Eastern Railway. He was also Chief Engineer of the Queen City Bridge Co.

Mr. JOHN MCCLELLAN, late resident engineer on, the Manhattan Bridge, over the Harlem river, New York, died suddenly on March 31, at his temporary residence in this city, aged about 45 years. Mr. MCCLELLAN'S home was in Colla, Washington Co, N. Y.

Mr. H. FRAZIER, Roadmaster of the Birmingham division of the Louisville & Nashville, has resigned to accept the position of Superintendent of Roadway of the Chesapeake & Ohio. Mr. C. A. DAVIS, formerly of the Memphis Division of the Louisville & Nashville, will succeed Mr. FRAZIER.

Mr. ORIN N. BALDWIN, for eight years Secretary of the Hyatt Pure Water Co., has resigned his position and will devote himself hereafter to selling filters and celluloid specialties. Mr. S. S. TIFFANY, for several years connected with the Hyatt Co., is now the Secretary of the company.

Mr. J. E. CHILDS having resigned as General Manager of the New York, Ontario & Western Railway, Mr. JOHN B. KERR has been promoted by President FOWLER to fill the place. Mr. CHILDS becomes Assistant General Manager of the Lake Shore & Michigan Southern.

Mr. JOHN C. PAUL has been appointed Superintendent of Equipment of Pullman's Palace Car Co., with office at Chicago. He will have charge of the repairs and maintenance of all cars and supervision of the repair shops. The Baltimore Division of this company will hereafter be known as the Southern Division.

Mr. C. M. LEVY is to be General Superintendent f the St. Louis, Keokuk & Northwestern and Chicago, Burlington & Kansas City railways, with headquarters at Burlington, Ia. Mr. W. E. CUNNINGHAM, who has been Assistant Superintendent, is to be Superintendent of the St. Louis, Keokuk & Northwestern railway, with headquarters at Hannibal, Mo.

PUBLICATIONS RECEIVED.

—*Report of the City Engineer of Kansas City, Kan.*—This is the report of Mr. A. W. BOEKE, City Engineer, on the work done from May, 1887, to December, 1888, and appended to it is the report on the sewerage system, by KIERSTEAD & PEARSON, Consulting Engineers, of Kansas City, Mo.

—*Proceedings of Annual Meeting of Iowa Society of Civil Engineers and Surveyors.*—Meeting held at Des Moines, Ia., January 8, 9, 1889. "Water-Ways," E. M. GILCHRIST; "Stone Arch Bridges," M. TSCHIRGI, Jr.; "Land Surveying in Pennsylvania," JAMES MCCLURE; "Some Paradoxes," SETH DEAN.

—*Annual Report of the City Engineer of Kansas City, Mo.*—Report for 1888, with maps, by JOHN DONNELLY, City Engineer and Water Commissioner.

—*The Cast-Steel Works of Fried. Krupp*, of Essen, Germany, are very neatly and effectively advertised by their New York representatives, Thomas Prosser & Son, of 15 Gold St., in the form of a novel paper-weight. The top of the weight is celluloid, and this is covered by a very fine engraving of the Essen works. A nickel-plated vine and leather base completes the outfit.

SOCIETY PROCEEDINGS.

Building Material Exchange, New York.—At the eighth annual meeting the following officers were elected: President, JAMES ROGERS; Vice-President, ROBERT S. SINCLAIR; Treasurer, HIRAM SNYDER.

Minneapolis Society of Civil Engineers.—At the recent annual meeting a paper on "The Panama Canal," was read by Mr. W. W. REDFIELD.

Engineers' Club of Kansas City, Mo.—At the regular meeting on April 1, President O. B. GUNN in the chair the paper of the previous meeting was discussed by Messrs. GOLDMARK and BREITHAUPT. The latter stated the approximate cost of the bridge repairs described as one cent per pound.

A paper was read by Mr. KENNETH ALLEN, on "Pollution, with Especial Reference to Water Supply and Sewerage." Organic impurities were especially referred to; their detection by chemical and biological analysis; the character and action of bacteria briefly described; and the allowable limits of impurities mentioned. After discussion by Messrs. BREITHAUPT, DECOURCY and ELLIOTT, the President introduced Dr. F. B. TIFFANY as a pupil of Dr. KOCH, of Berlin. Dr. TIFFANY exhibited specimens of anthrax bacilli, infusoria from hay infusion, water from O. K. Creek sewer, and other specimens under microscopes magnifying 400 and 800 diameters.

KENNETH ALLEN, *Secretary.*

Engineers' Club of St. Louis.—At the meeting on April 3, President MEIER in the chair, O. E. HOVEY and H. KRUTZSCH qualified as members.

Mr. B. F. CROW read a paper on "Street Car Running Gear." A model was exhibited and explained in detail. Various forms of construction were described and the advantages and disadvantages of each explained. Dust was the great enemy of good service. It was a mistake to expect machinery of this kind to run too long without attention. The improvements made in recent years were pointed out. Col. MEIER, Prof. JOHNSON, Mr. J. A. SEDDON, Mr. ROBT. MOORE, Prof. NIPHER, Mr. HUBBARD and Mr. TAUSSIG took part in the discussion. The advantages of a perfectly clean track were shown, and explanations were given of various devices to accomplish this result. As yet, no device had proven sufficiently successful to be generally adopted. Much more power was required to drive a car when the track was dirty. The advantages and disadvantages of anti-friction rollers were pointed out. Col. MEIER promised the club a description soon of a new "tractor," in which the whole power delivered to the car was available for traction.

Mr. W. H. BRYAN read a paper entitled "Steam Plants for Electrical Service." The distinctive features of modern practice were explained, and the different factors entering into the problem discussed. Comparisons were made between plants arranged with a few large engines, driving counter shafting, from which the dynamos were belted, and the same plant arranged with direct connected engines. In the author's opinion the most important factor in the problem was the amount and hours of loading. The integral parts of a steam plant were discussed from the standpoint of their efficiency in an electrical station. Col. MEIER, Mr. W. BARTLETT, Mr. WHEELER, Prof. WOODS, Prof. GALE and Mr. RUSSELL took part in the discussion. Col. MEIER showed that petroleum fuel was not smokeless unless properly handled. Prof. GALE stated that in his opinion a large part of the friction in plants using shafting was due to the friction clutches. If the dynamos were located immediately above the shafts, or not far from there, the dynamos could be thrown out of service without the use of clutches. He also stated that the friction could be reduced by covering the pulleys with paper or leather. This would increase the inefficiency of belt contact, and thus enable the belts to be run at less strain, reducing the friction in the journals.

WM. H. BRYAN, *Secretary.*

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Hereford.—D. WILLIAMS, of Cookshire, P. Q., Chief Engineer, writes us that the masonry and superstructure for 3 Howe truss bridges have been completed since Jan. 1, and that two others are in process of construction. Since Feb. 15, a mixed train has been run between the International boundary and Cookshire. The surveys for the Dudwell extension have been completed, and a very favorable route was secured with light grades and curves. Good progress has been made in obtaining right of way, and it is expected that construction will begin soon.

New York, Lake Erie & Western.—A large quantity of new 74-lb. steel rails is being laid on the main line between New York and Buffalo.

McKeesport & Belle Vernon.—It is reported that this company proposes to extend its line to the Cheat river lumber district. Work is in active progress on the line from Elizabeth to Belle Vernon, 18 miles.

Flint & Pere Marquette.—This company has contracted for 10,000 tons of steel rails to be used in changing the Port Huron & Northwestern Ry., recently acquired, to standard gauge.

Rome, Watertown & Ogdensburg.—This company is double-tracking its line between Brinker place and Rattlesnake point. The loop at Windsor beach is also being double-tracked, and the contract for changing the alignment of the track for about ¾ miles, near Rochester, has been let to Ward Bros., of Kennebunk, Me.

Cleveland, Chagrin Falls & Northern.—This company has given a mortgage to the International Trust Co., of Boston, to secure a loan of $300,000 for the purpose of completing their line. The road is to run from a point near the mouth of the Chagrin river via Chagrin Falls to South Solon. T. W. WARDWELL is President.

Allegheny Valley.—A petition has been filed in the United States Circuit Court for the appointment of a receiver for this road. It is charged that the road has been managed in the interest of the Pennsylvania Co. to the disadvantage of the stockholders' and they ask that a receiver be appointed who will represent them instead of the Pennsylvania Co.

American Midland.—At a meeting of the stockholders of the Ohio, Indiana & Missouri River Ry. and the New York, Mahoning & Western, recently held, a consolidation of the two companies under this name was effected. The officers are: WM. THORPE, President; DAVID JOHNSON, Vice-President; JAS. F. FOX, Treasurer, and THEO. FOTHERINGHAM, Secretary; all of New York.

Pennsylvania.—It is announced that surveys are in progress, in the interest of this company, for a road to run from Rochester, Pa. to Kenwood, Pa.—— A loop line, which will leave the main line on the Hackensack Meadows and cross the Passaic River Meadows, joining the main line near the Waverly Fair Grounds, is being discussed. The proposed loop is to avoid the slowing down of fast trains as required by the Newark City ordinances.

New York, Lake Erie & Western.—It is reported that surveys are in progress for the extension of the Orange branch of this road to Morristown, N. J.

Hoosac Tunnel & Wilmington.—It is rumored that the Deerfield River Co's. R. R. leased by this company is to be extended from its present terminus at Readsboro, Vt, via Whitingham and Jacksonville to Wilmington, Vt., about 14 miles.

Detroit, Lansing & Northern.—This company has secured the right of way, and will extend the Reed Lake spur out of the city of Grand Rapids, Mich., to a connection with the Detroit, Grand Haven & Milwaukee R. R., a distance of 4 miles.

Projects and Surveys.

Lockport Northern.—This company, whose organization was noted in our issue of Feb. 16, has been incorporated with the following officers: President, WM. SPAULDING; Vice-President, WM. T. RANSOM; Treasurer, JOHN HODGE, and Secretary, CHAS. A. HOAG. The road is to run from Lockport, N. Y., to New Fane Station on the Rome, Watertown & Ogdensburg R. R., a distance of 10 miles.

Washington & Sandy Springs.—Organized in Maryland, with, O. H. B. CLARK President; E. G. EVANS, Vice-President; J. L. HUSBAND, Secretary, and H. M. BAKER, Treasurer, to build a railway from Washington, D. C., to Sandy Springs, Md. Surveys will be made at once.

Springfield & Claremont.—It is reported that the surveys for this road, which is projected to run from near Gassetts, Vt., to Claremont, N. H., a distance of about 15 miles, have been finished.

Kinsua Valley.—Incorporated in Pennsylvania to build a railway from Riderville to Morrison station, a distance of 15 miles. S. S. BULLIS, of Olean, N. Y., is President.

SOUTHERN.—Existing Roads.

Ohio Valley.—A correspondent informs us that track laying has been completed from Hudson to Evansville, 10 miles, and that work is now in progress on the incline at the Ohio river. It is expected to put the line in operation from Princeton to Evansville about April 15. The road is projected from Princeton to Nashville, Tenn., about 90 miles. Thirty miles of this has already been surveyed.

Florida Railway & Navigation Co.—A press report states that this company will soon begin work on an extension from Quincy, Fla., to Columbus, Ga., about 150 miles.

Jacksonville, Tampa & Key West.—Tracklaying is in progress on the Jupiter & Lake Worth branch of this road, and it is expected to have the road finished within 30 days.

Chesapeake & Ohio.—It is stated that the entire line is shortly to be laid with 75-lb. steel rails.

Farmville & Powhatan.—It is stated that this road will be consolidated with the Bright Hope Ry. as soon as 32 miles of the Farmville & Powhatan has been completed and ready for operation. The grading has been completed and tracklaying will commence at once. The total length of the consolidated roads will be about 96 miles.

Georgia Southern & Florida.—Eight miles of this road from Valdosta is now ready for the rails, and it is expected that the first 15 miles will be completed by May 15, and 63 miles to Lake City, Fla., by July 4.

Richmond & West Point Terminal.—It is reported that the Chester & Lenoir R. R. will be changed to standard gauge and extended from Lenoir, N. C., to Blowing Rock, N. C.

Louisville, New Orleans & Texas.—It is announced that the Lake Washington branch of this road will be extended to Rolling Fork, Miss.

Savannah, Americus & Montgomery.—Work is being pushed on the eastern extension to McRae. It is stated that the company will build the road to Savannah on the condition that a subscription of $50,000 be raised by the citizens to aid the enterprise.

Kentucky Midland.—The 650-ft. iron bridge across the Kentucky river, near Frankfort, has been finished, and it is expected that the road will be in operation to Georgetown by May 1.

Dover & Statesboro.—We have received the following

information from F. T. LOCKHART, of Augusta, Ga., President:

This road is to run from Dover, Ga., via Statesboro, Excelsior and Reidsville to Way Cross. The line has been located from Dover to Statesboro and about three-fourths of the grading has been finished. The work is light and the grades and curves easy. The contract for grading has been let to JOSEPH H. BURCKHALTER and C. K. LEITNER has the contract for cross-ties and trestles. The right of way has been secured from Dover to Statesboro. It is expected that the road will be open for traffic by May 15. The company was incorporated Jan. 25, 1889. GORDON GAIRDNER is Chief Engineer.

Projects and Surveys.

Chattanooga, Cleveland & Murphy.—Mr. HENRY E. COLTON, of Murphy, N. C., Vice-President and Chief Engineer of this road, sends us the following description of the enterprise:

The above railroad, formerly known as the Hiawassee Railroad, was surveyed from Murphy, N. C., to Chattanooga, Tenn., in the fall and winter of 1867-68. On January 1, 1889, with my assistant, Mr. J. M. BLACKBURN, I commenced a revision of this line and also location from Murphy west, at the same time putting on hands clearing the right of way.

In the preliminary survey there were six tunnels between Murphy and Cleveland, with a total length of 9,900 ft., and a maximum grade of 70 ft., except for 1¼ miles where it was 90 ft. The average grade was about 1 per cent. No curvature over 6°. This was done to get a short line.

By our revision we have avoided all the tunnels but one, and reduced that to a length of 900 ft. The maximum grade has been reduced to 26.3 ft. per mile and the average for 60 miles to 15 ft. per mile, while we have lengthened the road only 9 miles, from 66 to 75 miles, from Murphy to Cleveland. In this distance we pass within less than a mile of mountains 3,000 ft. above sea level. With all this decrease of grade, we have only three 6° curves, and they are on level line. All the rest are from tangent to 6°. One mountain range, which every one said we could not pass without a 4,000 ft. tunnel, we ran around, taking off about 20 ft. of its point, with a 6° curve on level grade, and have above and below it 4 miles of level line.

We are enabled to do this from the fact that we follow the Hiawassee river the entire distance to Hiawassee gap, or rather below into Savannah farm, a distance of 52 miles. The Hiawassee river is one of the most singular streams in any mountain country. From the head of steamboat navigation on Savannah farm to its highest spring in the Blue Ridge mountains in Georgia, over 100 miles, the average fall by actual measurement by the U. S. Engineers is only 19 ft. per mile, and the maximum fall of any one mile is only 65 ft.

The Chattanooga, Cleveland & Murphy Railroad is to be a great mineral railway; it will bring out the iron and manganese ores, wood, marble, and talc from the immense veins and beds of those minerals along its line. With these easy grades, it is easy to be seen that those minerals and the vast virgin timber wealth of that region can be put on the market at a very low freight cost.

The line is now being carefully located and cross-sectioned for work. The cost of grading has been so reduced that it is known that the entire line can be graded, cross-tied and laid with 60-lb. steel rail for $16,000 per mile certainly, and in all probability $15,000 or less. The right of way has been cleared for about 5 miles.

The original interest and charter of this road was to go on to Augusta, Ga., but it has been determined to build from Cleveland, Tenn., to Murphy, N. C., first and then determine as to extension. The distance from Chattanooga to Augusta via Murphy would be 56 miles shorter than by present lines and it is the only route on which a low grade and easy curvature is possible. The extension up the Hiawassee above Murphy would develop a very rich mineral region, in fact the line thus extended would, for 125 miles, be continuously in or contiguous to ore or valuable mineral deposits.

Mobile & Tennessee River.—It is stated that work on this road, which is to run from Mobile via Birmingham, Sheffield and Florence to the Tennessee river, about 375 miles, will be commenced immediately.

Tennessee & Alabama.—This company has been organized to build a railway from Winchester, Tenn., to Scottsboro, Ala., about 37 miles. J. L. GIRTON is President; M. A. LEAK, of Stevenson, Ala., is Vice-President; H. P. WIGGS is Secretary, and W. B. YOUNG is Treasurer.

Mexican Gulf, Pacific & Puget Sound,—Incorporated in Florida by S. N. VAN PRAAG, A. G. MORENS, D. BURNS and others of Pensacola, to build a railway 45 miles long.

Bird Eye Coal Co.—It is announced that the Bird Eye Coal Co., of Jellico, Ky. will build a coal road 6½ miles long and equip it with a locomotive and cars.

THE NORTHWEST.—Existing Roads.

Duluth & Winnipeg.—The land grant bill, recently defeated in the Minnesota Legislature, was not, as might be inferred from the statement in our issue of March 30, an act of forfeiture; but a bill extending the time in which the grant could be earned, the effect of which would be to shut off some threatened litigation. The company failed to comply with the terms of the grant by not completing the road within the specified time, but the district court has decided that the title is good until a direct act of forfeiture has been passed by the Legislature. A forfeiture bill, introduced early in the session, was defeated, and another of the same tenor is now before the Legislature. It is stated, however, that the funds necessary to build the road as surveyed to the Mississippi river are at hand, and that work will be resumed within a few weeks.

Chicago, St. Paul, Minneapolis & Omaha.— The annual report of this company for 1888 shows as follows:

Gross earnings	$6,411,136
Expenses	4,648,157
Net earnings	$1,762,981

St. Paul & Duluth.—The annual report of this road for 1888 as compared with the previous year shows as follows:

	1888.	1887.
Gross earnings	$1,524,918	$1,694,339
Operating expenses	1,152,188	1,122,399
Net earnings	$372,730	$571,940

Winona & Southwestern.—It is stated that this company has secured the needed funds for the construction of its road from the present terminus to Mason City, Ia. There will be considerable rock work, and two tunnels, 1,825 ft. and 475 ft. long respectively, will be built. D. M. WHEELER, of Winona, Minn., is Chief Engineer.

Winnipeg & Hudson Bay.—Press dispatches from London, Eng., state that this company is trying to induce the imperial government to veto the bill recently passed by the Manitoba Legislature, repealing the act offering a guaranty upon $4,500,000 for 25 years in aid of this enterprise, and reducing the aid to a cash subsidy of $600,000.

Projects and Surveys.

Fairchild & Mississippi River.—Incorporated in Wisconsin to build a line of railway from Fairchild, Wis., through the counties of Eau Claire, Clark, Jackson, Trempeleau, Marathon, and Buffalo to a point on the Chicago, Burlington & Northern R. R., with a branch from Fairchild to some point on the Wisconsin Central R. R., a total distance of about 100 miles. N. C. FOSTER, of Fairchild, is President, and C. M. WILSON is Secretary.

THE SOUTHWEST.—Existing Roads.

Kansas City, Rich Hill & Eldorado.—A press report states that this road, which is to run from West Eldorado, Cedar county, Mo., to Rich Hill, a distance of about 30 miles, has already been graded 6 or 8 miles west of Eldorado. Frank P. Anderson, of Nevada, Mo., has the contract to build the line. The officers are: E. H. BROWN, of Girard, Kan., President; H. E. ASHCROFT, of Philadelphia, Pa., Vice-President; JOHN. T. MORRISON, Secretary, and R. T. RAILEY, Treasurer.

Projects and Surveys.

Golden Lake & Frenchman's Bayou.—This company has been incorporated with T. A. BARTON, President, and W. P. BARTON, Secretary, to build a tramway from Golden Lake, Ark., to Walnut Grove, Ark.

Bowers & Piney Creek.—Incorporated in Texas to build a railway from Bowers, Polk county to the mouth of the Piney creek, a distance of 10 miles. The capital stock is $50,000.

Shreveport & Texarkana.—This company which proposes to build a railway from Shreveport, La., to the Arkansas State line has elected the following officers; President, R. T. COLE; Vice-President, JOHN R. JONES, and Secretary, T. S. SHORT.

Camden & Alexandria.—Incorporated in Arkansas to build a line of railway from Camden south to the Louisiana State line, a distance of about 200 miles. The capital stock is $450,000.

San Angelo & El Paso.—It is rumored that a railway is to be built from San Angelo, Tex., to El Paso, Tex., an estimated distance of 350 miles.

ROCKY MT. AND PAC.—Existing Roads.

San Diego, Cuyamaca & Eastern.—This road has been opened for traffic from San Diego to Lakeside, a distance of 22 miles. It is stated that the road will be extended to an intersection with the Atlantic & Pacific R. R. at a point about 40 miles east of The Needles, thence to connect with the Union Pacific at Frisco. A branch will also be built from some point between Cuyamaca and San Diego to Colton.

Union Pacific.—The ordinance granting this company right of way for the branch from Omaha, Neb., to Lake Manawa has passed the city council, and according to the terms of the contract, work will begin within 90 days.

Chicago & Northwestern.—A press report states that work on the extension of the Fremont, Elkhorn & Missouri Valley R. R. from Fort Casper, Wyo., to Ogden and Salt Lake, Utah, about 500 miles, will be commenced soon, and it is expected to have the extension completed by Oct. 1. A branch road is also projected from Lander, Wyo., to the southern line of Yellowstone Park.

Silverton.—Surveys are to be made as soon as weather permits for the extension of this Colorado road from its present terminus near Ironton, to Ouray, a distance of about 15 miles. A branch is also to be built from Silverton to Eureka, 10 miles. OTTO MEARS, of Silverton, Col., is President and General Manager.

Southern Pacific.—C. P. HUNTINGTON, Vice-President, is quoted as saying that considerable track will be laid on this company's extension in California during this season. The principal work will be done on the coast line to Santa Barbara, from Oakdale down the San Joaquin Valley, and the building of a line around the Monterey peninsula, about 14 miles long.

Carson & Colorado.—It is stated that this company will extend its road from Owens Valley to Mojave, Cal., on the condition that Los Angeles subscribes to $500,000 of bonds.

Denver & Rio Grande.—A corps of engineers are making the locating survey for the Pike's Peak R. R. It is stated that construction will commence as soon as the weather permits.

Wyoming, Salt Lake & California.—It is stated that the contract for grading the first 10 miles of this road has been let and that work will commence at once. The road is to run from a point on the Wyoming line, about 14 miles south of Hillard, Wyo., via Coalville to Salt Lake City, about 65 miles. It is incorporated in the same interests as the Salt Lake, Nevada & California R.R. and will be consolidated with it.

Projects and Surveys.

Los Angeles, Pasadena & Glendale.—Incorporated in California to build a line of railway from Los Angeles to Pasadena, about 9 miles, and from Los Angeles to Glendale and Verdugo Park. Among the incorporators are JOHN CROSS, G. W. MORGAN, NATHAN COLE, JR., R. C. KERENS, and B. F. HOBART.

Tumwater & Olympia.—A railway company by this name has been organized in Washington Ter. The officers are: GEO. D. SHANNON, President; E. M. WILSON, Vice President; S. C. WOODRUFF, Secretary, and N. H. OWINGS, Treasurer.

Los Angeles & Hueneme.—It is reported that the surveys have been finished for this road, which is to run between Los Angeles and Hueneme, Cal., a distance of about 75 miles.

Redondo.—A project is on foot to build a narrow gauge railway from Los Angeles to Redondo Beach, a distance of about 22 miles. S. O. BROWN, W. H. BONSALL, L. P. GARNSEY and others of Los Angeles, Cal., are interested.

Siuslaw & Eastern.—The officers of this company, which proposes to build a railway from Siuslaw via Eugene City to the eastern boundary of Oregon, are as follows: President, A. G. HOVEY; Vice-President, W. A. COX; Secretary, J. M. HODSON, and Treasurer, E. C. SMITH. The general offices will be at Eugene City, Ore.

Silverton & Rico.—A project is being agitated to build a railway from Silverton, Col., to Rico, Col., a distance of about 21 miles. The cost of the road is estimated to be about $350,000.

RAPID TRANSIT.

Electric Railways.—***Salem, Mass.***—The Naumkeag Street Ry. Co. proposes to extend its Sprague electric line.——A new company proposes to build an electric line on the Enos system to Peabody, and another company proposes to run storage battery cars on the city lines.

Tarrytown, N. Y.—The Port Chester, White Plains & Tarrytown Electric Ry. Co. has been granted a franchise to build its line through Greenburg. Contracts have been let for the power house.

Jamestown, N. Y.—The street railway company proposes to extend its line and adopt an electric system.

Philadelphia, Pa.—A storage battery motor has been tried recently on the Germantown branch of the People's Line.

Wilmington, Del.—The Wilmington City Passenger Ry. Co. has decided to build an electric line on 8th St. The cost is estimated at $40,000. The Sprague system will probably be used.

Green Bay, Wis.—The Green Bay & Fort Howard Electric Railway & Power Co., of Chicago, has been incorporated by H. WARD LEONARD, C. M. IZARD and M. L. COFFEEN. Capital stock, $100,000.

Kansas City, Mo.—The Vine Street dummy line is to be equipped with the Thomson-Houston electric system at a cost of $50,000. It is about 2 miles long and is to be extended 1 mile.

Walla-Walla, Wash. Ty.—The street railway company has decided to adopt electricity for the new line to be built this summer.

New Birmingham, Tex.—The New Birmingham Electric Light, Power & Street Ry. Co. has been incorporated by Capt. M. D. MATHER and D. R. B. WICKES, of Austin, and W. J. NEEDLES, of Philadelphia. Capital stock, $50,000.

Austin, Tex.—The street railway has been purchased by THOMAS J. HURLEY, of Fort Worth, for $120,000. It will be extended 5 miles and equipped with electricity at a cost of $200,000.

Street Railways.—***Stillwater, Minn.***—The Stillwater Street Ry. Co. has been granted a license by the County Commissioners to operate over any streets and highways in Stillwater and Baytown.

Natchez, Miss.—No bids have been received by Mr. T. J. NICHOLL, President of the Natchez Street Ry. Co., for the construction and equipment of the projected line 2 miles long.

Topeka, Kan.—The Topeka City Railway Co. will build considerable extensions this spring.

LittleRock, Ark.—A street railway company has been organized to build a line about a mile long; there will be a single track on two parallel streets. LEARIN REINMAN is interested.

Omaha, Neb.—The Omaha Street Railway Co. has been organized by the consolidation of the Omaha Horse Ry. Co. and the Omaha Cable Tramway Co. Capital stock, $4,000,000. President, FRANK MURPHY; Secretary D. H. GOODRICH.

Cheyenne, Wyo.—The Cheyenne Street Ry. Co. will extend its line to Camp Carlin, 2 miles distant, and will also build several extensions in the city.

Tyler, Tex.—The Tyler Street Ry. Co. is negotiating for materials and equipment.

Rusk, Tex.—The Rusk & New Birmingham Street Ry. Co. has been incorporated by N. J. OWEN, S. BRYMAN, W. E. HOLMES, and others, to build a street railway, to be operated by horses, steam or electricity. Capital stock, $50,000.

Cable Railways.—*Washington, D. C.*—The Washington & Georgetown Ry. Co. expects to put in a cable system on its 7th St. line.

Chicago, Ill.—The West Chicago Street Ry. Co. has awarded the contract for its cable engines to the Providence Steam Engine Co., of Providence, R. I. The engines will be of 2,000 H. P.

Peoria, Ill.—The Peoria Cable Ry. Co. has applied for a franchise to build a cable line.

Denver, Col.—The Denver City Cable Railway Co. has had $83,000 of $150,000 subscribed for its West Colfax Ave. line. The line will be about 3 miles long.

Portland, Ore.—The contract for the cable engine house has been awarded to J. E. Bennet at $40,000.

Seattle, Wash. Ty.—The Front St. Ry. Co. will extend its cable line 3 miles to Green lake if a subsidy is granted. It will require a new power house for the extension.

Los Angeles, Cal. — The cable lines are nearly completed. Mr. A. W. WRIGHT is Chief Engineer, and Mr. J. C. ROBINSON is Vice-President and Superintendent.

San Francisco, Cal.—The San Francisco Railway Co. has been incorporated by CORNELIUS O'CONNOR, R. P. HASTINGS, and A. E. DAVIS. Capital stock, $2,500,000.

Dummy Lines.—*Atlanta, Ga.*—The cost of the North Atlanta Dummy Line is estimated at $100,000. J. R. GRAMLING is interested.

Dadeville, Ala.—A dummy line is to be built by B. F. PONDER, of Opelika. Surveys are to be made at once.

Montgomery, Ala.—A belt line is to be built by W. F. VANDIVER, F. M. BILTINGS, and W. F. JOSEPH.

Oceanside, Cal. — The Coast Motor Co. has been granted a franchise for a dummy line.

CONTRACTING.

Street Work.—*Brooklyn, N. Y.*—The following proposals for Belgian block paving and blue stone curbing on Fulton Ave. have been received by JOHN P. ADAMS, Commissioners of City Works: Charles Guidet, $12.90 and $13.12 per lin. ft. on different parts of the avenue; Thomas McCann, $11 and $12; Michael Henry and S. P. McGivney, $8.47 and $9.63; John Hart, $7.79 and $8.07; Thomas Monahan, $8.19 and $7.85; John Luck and P. H. Fitzgerald, $7.29.

Parkersburg, W. Va.—The City Council has awarded the contract for curbing to Martin McNerney, for hard sandstone, at 40 cts. per ft.

Burlington, Ia.—The following bids have been received for improving Main St.: John Loftus and Chas. Hanson, 63 cts. per lin. ft. for curbing, $2.19 per sq. yd. for brick paving, $3.00 per sq. yd. for granite paving. Granite Brick Co.: 76 cts., for curbing, $1.88 for brick paving. J. E. Riley & Co., Omaha, Neb.: 80 cts. for curbing, $1.85 for Burlington brick, $1.91 for Galesburg brick, $2.75 for granite. James Kelley: 60 cts. for curbing, $1.99 for brick paving. E. Kropp & Co.: 62½ cts. for curbing, $1.95 for brick, $2.99 for granite.

Sewers.—*Newark, N. J.*—Contracts have been awarded as follows: Boyden St. sewer: Satchwell & Bellingham, 80 cts. per ft. for 10-in. pipe, $102 each for basins, $30 each for manholes. Fifth St. sewer: P. H. Harrison, $1.12 and $1 for 15-in. and 12-in. pipe, $98 for basins, $30 for manholes. Ferry and St. Francis Sts. sewers: Satchwell & Bellingham, $2.74 for brick sewer, 90 cts. for pipe, $100 for basins, $25 for manholes. Chambers St. sewer: James Edwards, 74 cts. for 12-in. pipe, $97.50 for basins, $23.45 for manholes. Lock St. sewer: P. H. Harrison, 94 cts. for 12-in. pipe, $29 for manholes, ERNEST ADAM is City Surveyor.

Poughkeepsie, N. Y.—The following were received for the Balding Ave. sewer: Chas. Cook, $1,374.90; P. H. Ward, $1,418; Wm. O'Reilly, $1,941.34; Cruthers & Co., $1,968.24; Cornelius Daley $2,380.90. The contract was awarded to Chas. Cook at the following prices: rock excavation, $2 per cu. yd; 12-in. and 10-in. pipe, 60 cts. and 55 cts. per ft.: 12 x 6 branches, $1.65 per ft.; manholes, $35 each; silt basins, $125 each. The sewer will be 648 ft. long.

New Haven, Conn.—Contracts were awarded April 3 as follows by A. B. HILL, City Engineer:—George St. sewer: A. Brazos & Sons, Middletown, Conn.: $4.25 per ft. for 30-in., $3.50 for 24-in., $2 for 18-in., $1.70 for 15-in., $1 for culvert, $100 each for catch basins, $50 each for manholes; total, $10,283.——Poplar St. sewer: A. Brazos & Sons: $4.35 for 30-in., $4 for 24-in., $2.50 for 18-in., $1.80 for 15-in., $1.35 for 12-in., $1 for culvert, $100 for catch basins, $50 for manholes; total, $8,841.50.——Dewitt and Portsea Sts. sewer: L. O'Brien, New Haven, Conn.: $3.25 for 24-in., $2.20 for 18-in., $1.70 for 15-in., $1.20 for 12-in., $1 for 9-in., $1.20 for culvert, $110 for catch basins, $50 for manholes; total, $5,280.50.——Baldwin St. sewer: C. W. Blakeslee & Sons, New Haven, Conn.: $1.79 for 15-in., $1.40 for 12-in., $1.18 for culvert, $100 for catch basins, $50 for manholes; total, $1,412.80.

Watervliet Arsenal.—Three bids were received for the erection of the gun factory complete: A. Frederick & Son, Rochester, $179,800; Peter H. Buckley, Troy, $175,900, and Elnathan Sweet, Albany, $172,500. Of the bids on items, the lowest for erecting the masonry of the building was that of Stanton & Neary, Cohoes, at $54,500. The lowest bid on the iron work was that of the New Jersey Steel & Iron Co., at $57,634. The lowest bid on the stone work was that of Martin Hunt, of Troy, for Hudson river blue-stone, $13,300.

For the railway scale the bids were: Elnathan Sweet, Albany, for the Fairbanks scale, $1,000; Howe Scale Co., Rutland, $1,100; Buffalo Scale Co., $439. The lowest bid for the railroad turn-table was that of Elnathan Sweet, of Albany, at $2,300. The scale will be 42 ft. long, and will have a capacity of 60 tons; the turn-table will be 55 ft. diameter, with a capacity of 60 tons. A railway track will be laid to connect with the Delaware & Hudson tracks.

Dredging.—The following proposals for dredging in the channel leading to the harbor at Baltimore were opened March 30, by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Baltimore, Md. The total amount is about 1,200,000 cu. yds., and the dredging will be to 27 ft.; part A, 300,000 cu. yds. in 20 to 25 ft. of water; part B, 400,000 cu. yds. in 20 to 26 ft. of water; part C, 500,000 cu. yds in 14 to 25 ft. of water. American Dredging Co., Philadelphia, Pa.: 11⅛ cts. per cu. yd. for all parts, $138,000. National Dredging Co., Wilmington, Del.: 11⅞ cts. for all parts, $140,000. Morris & Cumings Dredging Co., New York: 12 cts. for all parts, 12⅛ cts. for part B, $144,000 Geo. C. Fobes & Co., Baltimore, Md.: 12⅛ cts. for all parts, 16⅛ cts. for A, 12⅛ cts. for B, 10 ⅞ cts. for C, $147,600. P. Sanford Ross, Jersey City, N. J.: 12⅛ cts. for all parts, 16 cts. for A, 12¾ cts. for B, 11 cts. for C, $150,000. The contract was awarded to the American Dredging Co.

Stone.—The following proposals were opened April 4, by Lieut.-Col. JARED A. SMITH, U. S. Engineer Office, Portland, Me.: furnishing and placing stone on the breakwater at Bar Harbor, Me.: Fred. L. Andrews, Biddeford, Me., $1.10 per ton for outside and filling. Curit & Hamilton, Chebeague, Me., $1.45. Rufus A. Soule, Chebeague, Me., $1.46. Wm. S. White, Rockland, Me. $1.48. Thos. A. Rowe, Boston, Mass., $1.49. Chas. H. Edwards, Quincy, Mass., $1.58.——Stone jetties, training walls and bank protection in Saco river, Me.: Geo. W. Andrews, Biddeford, Me., 93 cts. per ton. H. M. Sargent and I. H. Webber, Chebeague, Me., $1.07. Chas. H. Bragdon and Wm. H. H. Bragdon, Biddeford, Me., $1.10. Fred L. Andrews, Biddeford, Me., $1.11.

Street Material—The following contracts have been awarded by Mr. BALCOMBE, Board of Public Works, Omaha, Neb.:—Wm. Forrestall: Sioux Falls granite on sand, $2.29 per sq. yd.; alleys, $2.39. J. E. Riley & Co.: Colorado sandstone on sand, $2.38½; alleys, $2.47½; alleys, Woodruff sandstone, $2.40½; Omaha hard burned brick on concrete, $2.05; cedar blocks on sand and plank, $1.39; on concrete, $1.68½ and $1.78½. Hugh Murphy: Woodruff sandstone on sand, $2.30. James Fox & Co.: Galesburg vitrified brick on sand, $2.35; on concrete, $2.44. Nebraska Paving Co.: Omaha brick on sand, $1.78 or $1.96 with top course vitrified; vitrified brick on sand $2.22. J. C. Regan & Co: sapless red cedar on sand and plank, $1.98, or $2.38 on concrete; cedar blocks on sand and plank, $1.42; cypress blocks on sand and plank, $1.39, or $1.79 on concrete. J. B. Smith & Co.: cypress blocks or cedar blocks on sand and stone, $1.68 or $1.61. E. E. Mangle & Co.: cypress or cedar blocks on sand and plank, $1.45, or $1.72 on concrete. Soper, Wells & Co.: cedar and cypress on sand and plank, $1.52; without tar, $1.41; on 1-in. plank and 2 ins. of sand, with 1½ galls. of tar, $1.33; on 2 ins. of sand without tar, $1.27; on 6 ins. of broken stone and sand with 2 galls. of tar, $1.69, or $1.59 without tar. Barber Asphalt Paving Co.: asphalt $2.68 and $2.98.

Granite.—The following proposals have been received by the Board of Docks, New York City: Terence Smith: Class No. 1 (422 headers and 350 stretchers, containing about 15,300 cu. ft.), $1.20: Class No. 2 (62 coping stones, containing about 5,000 cu. ft.), $2.25. Wm. Kidney, $1.23 and $1.64. Booth Bros. & Hurricane Isle Granite Co., $1.27 and $1.27. John Pierce, 99 cts. and $1.24. Francis H. Smith, $1.17 and $1.35. Augustine M. Newton, $1.08 and $1.18. Charles Guidet, $1.55 and $1.92.

Piles.—The Board of Docks has received the following proposals for 600 sound and straight yellow pine, spruce or cypress piles, 60 to 65 ft. long: Alfred J. Murray, $7.50 each; Beard & Kempland, $7.75 each.

Pipe Laying.—The Water Commissioners, Poughkeepsie, N. Y., have received the following proposals for laying water-pipes in Balding Ave., the pipe being supplied by the Commissioners: P. H. Ward, $279.75; Chas. Cook, $282; John Cruthers & Co., $323.25; Wm. O'Reilly, $354.25: Cornelius Daley, $404.50. The contract was awarded to P. H. Ward at the following prices: rock excavation, $1.50 per cu. yd.; laying 6-in. and 4-in. pipe, 32 cts. and 15 cts. per ft.; setting hydrants, 75 cts. each; setting 6-in. gates, 75 cts. each.

Pipe and Hydrants.—At Buffalo, N. Y., contracts have been awarded as follows; Buffalo Cast-Iron Pipe Co., $26.50 per ton for pipe, $30 per ton for special castings. Howard Iron Works, hydrants and gates. Ludlow Valve Co., valves, $10,944.

Tunnel.—Proposals for the construction of a water tunnel from the water-works grounds in an easterly direction under the bed of Lake Michigan, to a distance of about 5,000 ft., will be opened April 30 by Mr. E. SANDERS, Commissioner of Public Works, Lake View, Ill. Separate bids are to be given as follows:—1st. For tunnel complete, including shore and lake shafts, lake crib, lighthouse with electric machinery and incandescent lights, and all other labor and material necessary to complete the work, in accordance with plans and specifications; 2d. For tunnel, 5 ft. diameter, per lin. ft.: 3d. For tunnel, 6 ft. diameter, per lin. ft.; 4th. For shore shaft per lin. ft.; 5th. For lake shaft per lin. ft.; 6th For lake crib; 7th. For lighthouse; 8th. For electric machinery and incandescent lights. Plans and specifications have been prepared. Mr. SAMUEL G. ARTINGSTALL, C. E., of Chicago, is the engineer.

PROPOSALS OPEN.

Road Work.—About 3½ miles of macadam road. WM. T. STEDMAN, Peace Dale, R. I.

Street Cleaning.—For the remainder of the current year. THOMAS J. LANAHAN, Clerk, Board of Contract and Apportionment, Albany, N. Y. April 15.

Street Work.—Excavation, filling, curbing, flagging, brick and cobblestone paving, etc. THOMAS J. LANAHAN, Clerk, Board of Contract and Apportionment, Albany, N. Y. April 15.

Bridge. — Wooden highway bridge over Mill creek. GEO. K. REED, Lancaster, Pa. April 16.

Water-Works.—Construction of the superstructure of the terminal chamber of the low-service conduit at Bissell's point. Furnishing and erecting the iron work and gates of the terminal chamber of the low-service conduit and three waste chambers. HENRY FLAD, President, Board of Public Improvements, St. Louis, Mo. April 16.

Dredging.—About 50,000 cu. yds. N. H. HUTTON, Engineer of the Harbor Board, Baltimore, Md. April 16.

Street Work.—THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. April 19.

Pier Work.—New wooden pier and approach at Pier No. 61, East river; also repairing bulkhead. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. April 19.

Water-Works.—Water pipe, 4, 6, 8, 10, 12, 20 and 24-in.; hydrants, castings, stop valves, stop boxes, trenching and filling, lead, brass ferrules, etc. Supplies for the year ending April 1, 1890. E. W. FRAILEY, Superintendent of Public Works, Lancaster, Pa. April 24.

Cement, Pipe and Tile.—Cement, sewer pipe and drain tile to be used in the construction of public works during the ensuing season. JOHN J. GRANVILLE, City Engineer, East Saginaw, Mich. April 27.

Road Work.—Macadamizing, excavation, filling, masonry, wooden bridges, trestling, etc., for work on a large number of county roads. CHAS. C. WOODS, Clerk of Board of County Commissioners, Wheeling, W. Va. April 30.

Cement.—Portland cement, 100 tons; for Mare Id. navy yard. JAMES FULTON, Paymaster-General, U. S. N., Navy Department, Washington, D. C. May 4.

Dredging and Dikes. — Dredging in the Pamunky, Chickahominy and Rappahannock rivers; spur dikes in the latter. Gen. S. T. ABERT, U. S. Engineer's Office, Washington, D. C. May 6.

Stone. — Rubble stone. JOHN T. COOPER, Clerk of Committee on Roads and Revenue, Atlanta, Ga. May 8.

MANUFACTURING AND TECHNICAL.

Contractors' Plant.—Ryan & McDonald, of Waterloo, N. Y., manufacturers of contractors' and mining supplies, dump cars, etc., are about adding several thousand dollars worth of new and special machinery to their large plant, owing to the increased demand for their manufactures. In addition to small orders and single cars they have recently shipped 5 carloads of dump cars to Pennsylvania and 3 carloads to a contractor at Brooklyn, N. Y. (This shows that it pays to advertise in ENGINEERING NEWS.)

Time and Pressure Recorders.—Jarvis B. Edson, of 145 Broadway, New York, reports business active. For J. M. Diven, of the Elmira, N. Y., water-works, he has made 2 water pressure recorders, 1 steam recorder and 1 electro-mechanical water level indicator and alarm for the engine room. Sales have recently been made to the Holly Mfg. Co., of Lockport, N. Y. (11th order); Edison Electric Light Co., Paterson, N. J.; American Steam Gauge Co., Boston, Mass.; Dedham (Mass.) Water Co.; Hospital for the Insane, Jacksonville, Ill. (3d order); Chicago Screw Co.; Dorrance Grate Co., St. Louis, Mo.

The Hyatt Pure Water Co. announces that it is still the recipient of orders for its filters from the laundrymen and others, of Chattanooga, Tenn., who claim that without this particular filter the water is not good enough for them.

The Shiffler Bridge Co., of Pittsburg, Pa., is building a new girder shop, 60 ft. by 300 ft. and a new blacksmith and forge shop 85 ft. by 200 ft. Among other contracts, the company is erecting 4 viaducts and 2 girder bridges, aggregating 950 tons, for the Louisville & Nashville R. R; also a number of truss bridges and viaduct for the Louisville Southern and Pittsburg, Cincinnati & St. Louis roads.

Cars.—The Laconia Car Co., of Laconia, N. H., is building flat cars for the Barre railway.

The Wason Car Co., of Springfield, Mass., has recently completed some passenger cars for the Port Jervis, Monticello & New York.

John Stephenson & Co., of New York City, have an order for 30 cars for the Julien storage-battery system for the Fourth Ave. line.

The Gilbert Car Works, of Troy, N. Y., have turned out 6 cars for the New York Central & Hudson River.

The Jones Car Works, of West Troy, N. Y., have completed 125 cars for the West End Street Ry. Co., of Boston. The works have a large number of orders on hand.

J. G. Brill & Co., of Philadelphia, Pa., are building the passenger cars for the Barre railway.

The St. Charles Car Co., of St. Charles, Mo., has an order for 15 cabooses for the Union Pacific. Two parlor cars have been built for the Toledo, Ann Arbor & Northern Michigan.

The Muskegon Car Works, of Muskegon, Mich., have an order for 100 stock cars for the Union Pacific.

The Litchfield Car Works, of Litchfield, Ill., are turning out 12 box cars per day for an order of 250 for the Cincinnati, Hamilton & Dayton.

Locomotive Fire Boxes.—The Lake Shore & Michigan Southern is having built at the Schenectady Locomotive Works, Schenectady, N. Y., 3 passenger and 15 mogul engines, the fire boxes of which will be above the frames and extend outside of them. The experience of the road with some engines they have in service having the larger grate area, due to the fire box extending over the frames, is said to incline them to extend the practice, as these boxes show a material saving of coal over engines of the same general dimensions, but having the deep narrow fire box.

Locomotives.—The Portland Co., of Portland, Me., has recently completed 3 engines weighing 45 tons each for the mountain division of the Maine Central.

The Rhode Island Locomotive Works, of Providence, R. I., are building some more engines for the Kings County Elevated road, of Brooklyn, N. Y.

The Hinkley Locomotive Works, of Boston, Mass., have been shut down.

The Schenectady Locomotive Works, of Schenectady, N. Y., are building 3 eight-wheel passenger engines, 15 mogul freight engines, and 7 six-wheel switch engines for the Lake Shore & Michigan Southern; the passenger engines have cylinders 18 x 24 ins., with 66-in driving wheels; 5 of the moguls will have cylinders 17 x 24 ins., and the others 19 x 24 ins.—— They have also an order from the Union Pacific for 6 passenger engines with cylinders 20 x 24 ins., and 9 mogul engines. Two engines have lately been delivered to this road.——Several engines are being built for the New York Central & Hudson River, and the 2 locomotives of the "Strong" type are approaching completion.

The New York Locomotive Works, of Rome, N. Y., have an order from the Union Pacific for 6 engines with cylinders 18 x 26 ins., and 3 with cylinders 22 x 26 ins.

The Brooks Locomotive Works, of Dunkirk, N. Y., have delivered 5 heavy freight engines, weighing 94,000 lbs. empty, to the New York, Lake Erie & Western.—— Six engines are being built for the Kansas City, Fort Smith & Southern.

The Baldwin Locomotive works, of Philadelphia, Pa., are building 30 engines for the New Jersey Central.—— They have recently shipped 10 engines to the Argentine Republic.

Rix & Firth, of San Francisco, Cal., have completed a locomotive with cylinders 6 x 10 ins. for the Alaska Mining Co.

The Golden Lake Tram & Lumber Co., of Golden Lake, Ark., wants to purchase a second-hand locomotive.

American Trade with Australia.—Mr. W. H. GRIFFIN, U. S. Consul at Sidney, New South Wales, has returned to this country and reports that the colonists in New South Wales manifest much cordiality toward Americans, and desire to form closer trade relations with this country. They are more American than English in business matters, and in fact have adopted as nearly as possible American systems of conducting their public institutions. Mr. GRIFFIN'S report on the railways of Australia was abstracted in ENGINEERING NEWS, March 30, 1889.

Steel Works.—The Union Drawn Steel Company has been organized at Beaver Falls, Pa., with the following officers: President, W. H. HARTMAN; Vice-President, T. H. ADRIANCE, Poughkeepsie, N. Y.; Secretary and Treasurer, WILLIAM H. ANDERTON, recently of Carnegie, Phipps & Co.; Superintendent, W. A. MCCOOL. Work has been begun on the proposed site at lower end of Seventh Ave., and the works are expected to be in operation within 60 days. The building will be 50 ft. by 200 ft., one and a half stories

Oil Pipe Line.—The Denver & Wyoming Oil Pipe Line Co. has been organized, with a capital stock of $500,000. The object is stated to be the construction of a pipe line through Arapahoe, Jefferson, Boulder, Weld and Larimer counties, and such other counties as the exigencies of the case may demand. The incorporators are E. B. BARTON, DONALD FLETCHER, GEORGE L. AGGERS and others.

Steel Ties.—The Hartford Steel Railway Tie Co., Temple Court, New York City, is reported to have made arrangements with the Pennsylvania Steel Co. for the manufacture of the "Hartford" tie.

The Paterson Locomotive Trade.—One of the largest locomotive builders in the country, whose works are at Paterson, says there is scarcely any demand for locomotives just now. The locomotive establishments of the country can build about 3,000 engines annually, but at present the railroads are buying only about 1,000. A locomotive can be bought now for $8,000, or less than the cost of building; but it pays the shops to run, even at a moderate loss, instead of standing idle. The manufacturer says the railroads are 5 years ahead of the country —that is, that it will take 5 years for the country to grow sufficiently to give all the railroads now built enough business to make them pay. Just as soon as the population of the country catches up with the railroads, the business of locomotive building will revive.—Newark *Advertiser*.

The Coventry Locomotive.—This locomotive, which was intended to effect more complete combustion of the fuel by means of a return flue through the boiler, the smokestack being at the firebox end of the boiler, is reported as being converted to the ordinary type of engine at the shops of the Louisville, New Albany & Chicago road at New Albany, Ind.

Splice Bars.—The Tidewater Steel Co., of Chester, Pa., has orders for 80,000 pairs of splice-bars for the Georgia Central, 50,000 pairs for the New York Central, and 30,000 pairs for the Savannah, Florida & Western.

Steam Roller.—The Common Council, of Lancaster, Pa., has appropriated $784 for a steam road roller.

The Coke Co., of Connellsville, Pa., is about to develop a 1,200 acre tract of coking coal in the Connellsville basin, 6 miles west of Connellsville. The company is composed of Baltimore capitalists, among whom are ROBERT GARRETT, ex-senator DAVIS, of the West Virginia Central R. R., Kegen Bros., of the Baltimore Copper Co., and Col. O. LATROBE. Mr. B. S. RANDOLPH, of Frostburg, Md., is the company's mining engineer.

The Knox County Paving, Building, Brick & Tile Co., of Galesburg, Ill., has been incorporated; capital, $65,000; for the manufacture of brick, terra cotta, tile and sewer pipe, Incorporators, W. S. DEWEY, JOHN BOSSLER and IRUS COYA.

Well Works.—The United States Well Supply Co. has been organized at Valparaiso, Ind., with a capital of $10,000. The directors are EUGENE SMITH and JOHN G. WOOD, Chicago; J. W. STRATTON, GEO. F. BARTHOLOMEW, C. H. PARKER, of Valparaiso.

The Nashville Well Works & Tool Co. has begun work on the new buildings for its factory at Birmingham, Ala. There are six buildings to be erected as follows: one 150 x 50 ft.; one 60 x 40 ft.; one 50 x 40 ft.; two 40 x 40 ft., and an engine and boiler house 40 x 30 ft. All will be of brick. The shops are to be ready for operation by July 1, and will employ 250 men in the manufacture of windmills, well tools, and the like. The firm is now located at Niles, Mich.

Compound High-Speed Engines.—The General Manager of the Edison Electric Illuminating Co., of Brooklyn, N. Y., has selected this type of engine for the large central station now being erected at 360 Pearl St., Brooklyn, where the energy of 3,000 H. P. will be sent out in electric currents through an underground system radiating through nearly a mile in all directions from the station as a center. The engines for this work will be furnished by the Ball Engine Co., of Erie, Pa., the order having been placed with their New York agents, C. H. Vincent & Co., 15 Cortlandt St., for 12 engines of 250 H. P. each. The general plan of these engines will be of the double horizontal type with opposite cranks and one high-pressure and one low-pressure cylinder. Each engine will weigh about 30,000 lbs. Steam will be supplied at 125 lbs. pressure by a battery of Babcock & Wilcox boilers.

BRIDGES AND CANALS.

Bridge Notes —*Bethlehem Hollow, N. H.*—An iron bridge is to be built at a cost of $1,250.

Waterford, N. Y.—The contract for a lift bridge over the canal at Broad St. has been awarded by JAS. SHANAHAN, Superintendent of Public Works, to the Hilton Bridge Co., of Albany, at $6,600. The Groton Bridge Co., of Groton, N. Y., bid $7,280, and the King Iron Bridge & Mfg. Co., of Cleveland, O., bid $7,974.

Sandy Hill, N. Y.—The Town Board will build a bridge across the Halfway brook at a cost of $300.

Pittsburg, Pa.—Mr. BIGELOW, Chief Engineer of Public Works, is reported as stating that a new bridge over the Allegheny river will be built this year.

Berlin, Md.—JOSEPH D. BAKER, of Frederick, Md., has purchased the piers of an old bridge across the Potomac and will build an iron bridge.

Corriganville, Md.—The suspension bridge across Wills' creek is completed. It is 300 ft. span.

Richmond, Va.—The James river bridge is to be improved. REUBEN SHERRIFF is the engineer.

Wheeling, W. Va.—Work is progressing on the masonry and approaches of the Union railway bridge. Page & Cary are the contractors.

Parkersburg, W. Va.—A vote will be taken May 21 on the question of issuing bonds to build the Little Kanawha bridge.

Chattanooga, Tenn.—The County Court has decided to build a free bridge over the Tennessee. A meeting will be held May 1.

Lexington, Va.—The County Commissioners will build several new bridges.

Ty-Ty, Ga.—W. R. Glover has the contract for a bridge over the Alapaha river.

Macon, Ga.—An iron bridge will probably be built over Rocky creek to replace the one recently burned.

New Albany, Ind.—The Contract Committee has awarded the contract for an iron bridge over Falling Run creek, at W. 7th St., to the Columbus Bridge Co., of Columbus, O., at $3,300.

Port Washington, Wis.—The city has been authorized to issue $6,000 in bonds for bridge purposes.

New East River Bridge.—The scheme for a bridge to Long Island, across the East river at Blackwell's Island, has encountered an adverse decision in the Supreme Court, Judge VAN BRUNT having refused an application for the appointment of commissioners to acquire land. He upheld the argument of Assistant Corporation Counsel TWOMBLY, in opposing the application, that the Act of 1885 gave authority to a private company to lay railway tracks over the bridge in violation of the provision of the Constitution of the State.

Harbors.—The Brazos River Channel & Dock Co. has a large number of men at work at the new harbor at the mouth of the Brazos river. The jetties being constructed are 5,000 ft. long, with a channel 460 ft. in width between the jetties. The Chief Engineer is Mr. E. L. CORTHELL. The engineer in immediate charge of the work is Mr. GEORGE Y. WISNER. The contractor is GUSTAVE WILKS, who built the Texas Capitol. The contemplated improvements will cost between $2,000,000 and $3,000,000. The company has put a corps of engineers in the field, and will construct a railroad to Houston at once.

The Port Aransas Co. has been chartered to secure deep water at Aransas Pass and Corpus Christi, Tex., by ELIHU H. RHOPES, of New York, and R. W. SLAYTON and CHASE MILLER, of Corpus Christi. The capital stock is $5,000,000.

Canals.—Work has been commenced on the enlargement of the Dismal Swamp canal. It will be deepened and widened so as to allow a large-sized vessel to pass through. The lengthening and enlargement of the granite locks will also be made as early as possible.

The contract to build a canal to be used in draining the city of Helena, Ark., has been awarded to J. W. Stansell, of Memphis, Tenn.

ELECTRICAL.

Hackensack, N. J.—The following proposals for 200 electric lights of 30 or 50 c. p. have been received by Mr. TERHUNE, President of the Hackensack Improvement Commission: Edison United Mfg. Co.; $15 each per year for 30 c. p., or $25 for 50 c. p.; if only until 12 o'clock, 25 per cent. less. 2,000 lights for commercial and domestic purposes at not exceeding 83 cts. per month each, except where burned all night; or 1¼ cts. per hour for each light by meter furnished at expense of consumer. Attica Electric Light Co. (Edison system), $30 or $42. Marion Electric Light Co. (Heisler system), $21.80 for 30 c. p. C. H. Barney (Westinghouse system), $18.75 or $29.50. Easton Electric Light Co. (Ball system), $17.50 or $25. W. D. Chandler (Slattery system), $28 or $48. Bergen County Electric Co. (Thomson-Houston system), $25 or $37. J. D. Van Wagoner (Westinghouse system), $24 or $29. Hackensack Gas Light Co.; gas according to present schedule, $12.65 per light, $2,530; with lights for dark moon, $14.65; for all night and every night, $16.55. The contract was awarded to the Edison United Mfg. Co.

Electric Power.—The Northwest Electric Power Co., of Tacoma, Wash. Ty., has been formed by R. F. RADEBAUGH, I. W. ANDERSON, T. B. WALLACE and H. C. WALLACE. The object of the company is to generate, use or supply power by electricity. The company is incorporated for 50 years, and has a capital stock of $250,000.

Electric Light.—*Concord, Mass.*—The Concord Electric Co. has been organized. President, T. T. ROBINSON. Capital stock, $30,000.

Jamestown, N. Y.—The Jamestown Electric Light & Power Co. has made an offer to light the city at $6 per arc light per month.

Baltimore, Md.—An ordinance is to be passed providing for the electric lighting of streets, parks, etc., by the arc system. The price not to exceed 40 cts. per light per night.

Glens Falls, N. Y.—Bids for electric lighting for 1 and 5 years are to be invited.

Piedmont, W. Va.—The Piedmont Electric Light & Power Co. has been organized and will put in an arc light plant. President, P. S. MINSHALL.

Newton, N. C.—A vote on the issue of $10,000 in bonds for electric lighting, etc., will be taken May 6.

Goldsboro, N. C.—An electric light franchise has been granted to O. H. FOSTER, of Raleigh.

Newbury, S. C.—Electric lighting is contemplated. Address G. MCWHORTER.

Florence, S. C.—The Charleston Electric Light & Power Co. is putting in an electric light plant. Major GEO. B. EDWARDS is President.

Bainbridge, Ga.—Address the mayor in regard to the projected electric light system.

Atalla, Ala.—Address the mayor for information in regard to the projected electric light system.

Springfield, Ill.—A. L. Ide & Son have been awarded a 10 years' contract for electric lighting at $137 per annum for each light of 2,000 c. p.

Shelbyville, Ind.—A contract has been made with the Home Electric Light & Power Co. for 48 arc lights at $85 each per annum. President, JOHN BEGGS. Capital stock, $30,000.

Sheboygan, Wis.—An electric light franchise has been granted to A. F. Leberman.

Sedalia, Mo.—The Central Electric Light & Power Co., of Topeka, Kan., has a 5 years contract for electric lighting.

Livingston, Mont.—The Livingston Electric Light Co. has been organized by I. ORSCHEL, GEO. CHAMBERS and T. A. KRIEGER. Capital stock, $25,000.

Seattle, Wash. Ty.—For electric lighting plant the Northwestern Electric Supply & Construction Co. bid $36,400; the Westinghouse Electric Co. bid $22,000; the Seattle Electric Light Co. bid $5,000 less than its former estimate if an arc plant is not desired.

London, Ont.—The following bids have been received: Heisler Incandescent Co., $33,665, annual cost, $8,500; Royal Co., $23,000, yearly cost, $8,500; Brush Co., $35,529.-18; Westinghouse Co., $36,300; Western Co., $27,625, yearly cost, $8,500; Ball Co., $30,000, including station; Reliance Co., $26,300.

Winnipeg, Man.—The Water & Light Committee has received a tender for the electric street lighting of the city for the ensuing 3 years, and recommends that the contract be awarded to the Manitoba Electric & Gas Co. at 74 cts. per light per night for 75 lights, burning 25 nights per month.

WATER AND MUNICIPAL.

Irrigation.—*New Mexico.* The Pecos Irrigation & Investment Co. has placed contracts with W. C. Bradbury & Co., of Denver, Col., for the construction of two irrigating canals from 30 to 45 ft. wide on the bottom, and about 100 miles long, together with branches and laterals for irrigating lines, in the valleys of the Pecos river in southeastern New Mexico, and supplying water for the new towns of Roswell and Eddy, the work to be completed within 9 months. This new country is attracting considerable attention, and the recent surveys of the Chicago, Kansas & Nebraska R. R. from Liberal, Kan., to El Paso, Tex.; of the Santa Fé road from Pan Handle City to El Paso; of the Denver, Texas & Fort Worth road from Clarendon, Tex., to El Paso, and of the El Paso & Mexican road from Kiowa, Kan., to El Paso, all pass directly through this locality.

Drainage in Indiana.—The Indiana Legislature has appropriated $40,000 toward taking out a ledge of rock in the Kankakee river between Momence, Ill., and the Indiana State Line. This is to the end that a large tract of swamp land in Newton Co., Indiana, may be drained. Mr. W. M. WHITTEN, C. E., of South Bend, Ind., who has been appointed Chief Engineer, is expected at Momence shortly, to make a preliminary survey and estimates.

Salt Lake City, Utah.—The Capitol Grounds Commissioners have engaged Mr. F. STURGES, C. E., of that city, to make preliminary plans and estimates for reservoirs. His plans include two reservoirs, one holding 12,500,000 galls., and costing $17,000; the other holding 4,800,000 galls., and costing $6,800. The water will be obtained from City creek, twice a year, at flood times, through a ditch, one mile long, costing $1,200. The Capitol grounds contain 20 acres, and exclusive of evaporation, it is desired to furnish them 20 ins. of water, besides rainfall. Haviland & Seligman, of Salt Lake City, have done the field-work.

Hartford, Conn.—The Board of Water Commissioners has issued its report for the year ending March 1, 1889. During the year there were 11,849 ft. of cast-iron pipe laid, including 6,270 ft. to replace cement-lined sheet-iron pipes; 13 hydrants were set. The supply is taken from 5 reservoirs. There are now 747 stop-gates, 5,984 service pipes, 488 hydrants and 345 meters. Mr. EZRA CLARK is President and Superintendent. Mr. HENRY W. AYRES is the engineer in charge of the reservoirs.

Pumping Engines for New Jersey Water-Works.—Governor GREEN has approved House bill 123, giving cities power to issue bonds not exceeding $40,000 in one year to purchase new pumps for water-works where old pumps are not of sufficient capacity to supply such city with water through its limits.

New Bedford, Mass.—The Water Board has issued its report for 1888. During the year 27,055 ft. of main pipe were laid and 1,586 ft. taken up, 48 new hydrants set and 13 removed. The total length of distributing mains now in use is 59.2022 miles; there are 445 hydrants, 615 stop gates, 62 waste gates, 123 private stop gates, 27 motors and 108 meters. The total consumption was 1,229,841,794 galls. It is recommended that steps be taken to provide a new conduit and that night inspection for waste be resumed. Mr. R. C. P. COGGESHALL is Superintendent.

Highland, Col.—The stockholders of the Beaver Brook Water Co. have concluded to reorganize the company and greatly increase the capacity of the works. The present issue of $31,000 bonds will be taken up, and $70,000 more will be invested in enlarging the mains, the purchase of larger pumps and the sinking of additional artesian and driven wells. A system of filtered wells, 16 in number, similar to those in Brooklyn, N. Y., has recently been completed. A large Holly pump has also just been placed in. The company was organized in 1886, with a capital stock of $80,000. It secured a franchise. Bonds were placed to the amount of $31,000, and a plant, consisting of 10 miles of water mains and medium size pumps, was put in, which the proprietors believed was sufficient for at least 5 years, but the town has grown so rapidly that the works are inadequate to meet the demands. Mr. H. B. CHAMBERLIN is at the head of the company.

Bayonne, N. J.—Negotiations between the City Council and the Montclair Water Co. are nearly completed, and a contract has been prepared. This contract provides that the city shall pay $80 per 1,000,000 galls. of water to be delivered for 25 years, from Nov. 1, 1890; water to be pure and to be taken from the Passaic river or tributaries above Paterson; the company may also sell water to Jersey City; 10,000,000 galls. to be delivered daily, if required, and not less than 1,000,000 used; pressure to be 45 lbs. per sq. in.; Bayonne to give use of streets and city land if the company requires it to facilitate the work. Bayonne now pays $90 per million galls., amounting to about $40,000 per year.

New Haven, Conn.—The New Haven Water Co. has accepted the amendment to its charter, providing for an increase of capital, and has authorized the directors to take such action as they think advisable for increasing the water supply. The New Haven *Palladium* says:—"The company has recently acquired extensive water rights in Woodbridge, and in the near future will build a dam below the junction of the Sargent and West rivers at a point about 3,500 ft. from the Valley mill in Woodbridge. A Boston engineer will soon begin work on plans and specifications for the dam. Its construction will require about two years, but the cost has not yet been estimated. The location of this water supply, which will have a capacity of 300,000,000 galls., is so elevated that the water can be brought into the city and distributed by its own pressure. Consequently a reservoir and pumping machinery will be unnecessary."

Denver, Col.—The Citizens' Water Co. has been incorporated by members of the late Board of Directors of the Denver Water Co., who, as they could not carry on the business to meet the views of the principal stockholders, resigned, and organized a new company. The incorporators are DAVID H. MOFFAT, ERASTUS F. HALLACK, RICHARD HOLMES, GEORGE W. KASSLER, CHARLES P. ALLEN and W. B. MILLS. The capital stock is $3,000,000 The company proposes to carry out the plans which its members had wished to carry out for the old company, and the engineer, Mr. C. P. ALLEN, who was engineer for the old company, is making surveys and plans for the new works. The new works are to be sufficient for a population of 35,000. The water will be brought from such a distance that there will be no likelihood of its being affected in any way by the drainage from any municipality or stream of water. The system will be a gravity one, having sufficient fall to carry water to all portions of the city, including the Highlands and North Denver. It is probable that a separate line of pipe will be laid on the west side of the Platte for the purpose of supplying the two last-named places. It will take considerable money and time to establish the new system, but it is thought that it will be in operation in a year. The new directors of the Denver Water Co. are as follows: JAMES H. ARCHER, Vice President; FRANCIS P. MCMANUS, Secretary; T. L. HARDCASTLE, FRANK S. ARCHER, W. P. ROBINSON, F. W. HERBERT, JOHN H. PULLEYN and WILLIAM J. FAY.

Water-Works.—*Maine.* Alfred. The railway company will pipe a water supply to the town from a well.

Massachusetts.—Great Barrington. A meeting of the fire district was called for April 12 to decide if the district will vote to take by purchase or otherwise the property and franchises of the Berkshire Heights Water Co. and the Great Barrington Water Co.

New York.—Olean. A new pumping engine of 2,500,000 galls. daily capacity has been received. It cost $12,000.—Tarrytown. The village trustees have made a contract with the Pocantico Water Co.—Cohoes. The Water Board has directed the Superintendent to purchase 2,000 ft. of 6-in. and 1,000 ft. of 4-in. pipe.—Saratoga Springs. The new Gaskill engine, 8,000,000 galls. daily capacity, has been put in position.—Troy. A number of new meters are to be put in. For particulars address Superintendent BAERMANN.

New Jersey.—Bayonne. The Council has decided to contract with the Montclair Water Co. (Bartlett syndicate) for a supply of water at $80 per 1,000,000 galls. The contract is for 25 years, and if the company succeeds in effecting a contract to supply lower New York, the rate is to be reduced to $70. The new water is to be delivered by Nov. 1, 1890. The Council requested Mayor NEWMAN not to sign the contract until April 16, to enable Engineer RUMBLE to submit a proposition. He says he can furnish water at $60 per 1,000,000 galls., but has not submitted any formal proposition.

Pennsylvania.—East Stroudsburg. Calvin Detrick & Co., 45 Broadway, New York, have been granted a water-works franchise.

Georgia.—Waycross. Water-works are projected. For particulars address Mayor CARSWELL.

Alabama.—Anniston. The water-works will be built by T. G. BUSH, of Mobile.—Selma. The contract for the extension of the water system into the Robinson addition, North Selma, has been awarded to the Selma Water Co., its bid of $4,500 being the lowest. Work is to be commenced at once and completed in 60 days. It is in the interest of the Selma Land Co.

Tennessee.—Shelbyville. Water-works are projected. For particulars address the mayor.—Nashville. Bids were opened April 11 for laying 9,400 ft. of 36-in. main. The pipe cost $22.44 per ton.

Kentucky.—Mount Sterling. The Commercial Club is agitating for water-works.—Covington. The Reservoir Trustees claim that they will be able to turn water on from the new works by September. All the pipe connections in this city and Newport have been made, and work on the reservoir is being pushed rapidly.

Ohio.—Marietta. A vote is to be taken on the proposition to issue bonds for $100,000 to build water-works. This is the second time it has been voted on.

Michigan.—Bowaglac. The city has voted to issue bonds for $40,000 for water-works.

Illinois.—Peoria. The Water-Works Committee received 3 bids for water-works and has recommended that the contract be awarded to Moffett, Hodgkins & Clarke, of Watertown, N. Y.

Kansas.—Argentine. A water supply will probably be obtained from the Quindaro works instead of the city having its own plant.—Topeka. The Cook Well Co., of St. Louis, Mo., has a contract to furnish an increased supply of water for the water-works.—Smith Center. Water-works have been contracted for.

Nebraska.—Omaha. The sale of $1,000,000 5 per cent. water bonds is being advertised by the American Water-Works Co. C. H. VENNER & Co. are the agents in New York and Boston.

Texas.—Cleburne. The water works have been purchased by the Commonwealth Construction Co., of Philadelphia, Pa.—Dallas. It is reported that new works will be built at a cost of about $280,000.—San Angelo. Mr. HOLMES, of San Marcos, has made a proposition to purchase the works for $20,000, and to enlarge and extend them.

Oregon.—Baker City. The water-works are completed, and are said to be in successful operation.

Washington Territory.—Port Townsend. The Port Townsend Water Co. is making arrangements to derive the water supply from Anderson's lake. The President, Mr. H. L. TIBBALS, Jr., has put a party of surveyors in the field in order to locate a line for laying the pipe. Anderson's lake is situated about 9 miles south of the city, and is a considerable body of water, being about 4 miles long and 3 miles wide.

California.—Eureka. The Ricks Water Co. has been incorporated by H. L. RICKS, P. BELCHER, and S. L. SHUFFLETON. Capital stock, $150,000.—Santa Cruz. A jury has been secured in the case of the city against James Enright et al. to condemn water rights in the Laguna creek. The city voted to issue $300,000 bonds for the acquisition of public water-works, and has secured all the water rights on the creek except Enright's.—Oakland. Another submarine pipe of the same size as those already in place is soon to be laid across the bay from Dumbarton Point to the San Mateo shore by the Spring Valley Water Co. This will increase the delivery on the other side 10,000,000 galls. of water daily, making the discharge each day from the three pipes about 30,000,000.

Utah.—Salt Lake City. A reservoir will be built 180 x 200 ft. and 28 ft. deep. A pipe contract has been let to Dennis Long & Co., of Louisville, Ky.—Ogden. The following proposals have been received for building reservoir, etc., at the Territorial Reform School: W. W. Funge, Ogden, $1,600; L. Zitzmann, Ogden, $2,190; J. Thompson, Salt Lake City, $2,330; E. Sturgis Salt Lake City, $3,400. Contract awarded to W. W. Funge.

Canada.—Brantford, Ont. It is stated that the highest tenderers for the Brantford water-works debentures are Hanson Bros., Montreal. They offer to pay 96.55 for $60,000 worth and 96.06 for $125,000 worth. This is thought to be a very good figure for 30-year 4 per cent. bonds.